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Complete List of Authors:	Leong Bin Abdullah, Mohammad Farris Iman; Universiti Sains Malaysia, Advanced Medical and Dental Institute Murad, Nor Shuhada; Advanced Medical and Dental Institute, Universiti Sains Malaysia, Lifestyle Science Cluster Mohamad, Mohd Afifuddin; Advanced Medical and Dental Institute, Universiti Sains Malaysia, Lifestyle Science Cluster Teoh, Soo Huat ; Advanced Medical and Dental Institute, Universiti Sains Malaysia, Lifestyle Science Cluster
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Quality of life of university students during the COVID-19 pandemic: Assessing the level of quality of life and the associated factors after the end of movement lockdown in a cross-sectional study

Mohammad Farris Iman Leong Bin Abdullah[1]**, Nor Shuhada Murad[1], Soo Huat Teoh[1], Mohd Afifuddin Mohamad[1]

[1]Lifestyle Science Cluster, Advanced Medical and Dental Institute, Universiti Sains Malaysia, SAINS@BERTAM, 13200 Kepala Batas, Pulau Pinang, Malaysia

****Corresponding author:**

Mohammad Farris Iman Leong Bin Abdullah

Lifestyle Science Cluster

Advanced Medical and Dental Institute

Universiti Sains Malaysia

SAINS@BERTAM

13200 Kepala Batas

Pulau Pinang

Malaysia

Email: farris@usm.my

Tel: +604-5622482

Fax: +604-5622468

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ABSTRACT

Objectives: This study aimed to evaluate quality of life (QoL) and determine its association with various factors and social support among university students during the COVID-19 pandemic after the end of movement lockdown.

Design, setting and participants: This was an online, cross-sectional study recruited a total of 316 participants. Inclusion criteria included those who were 18 years and above and registered as students with the Faculty of Medicine of Malaysian public universities located in Klang Valley and the states of Penang and Kelantan in Peninsular Malaysia. While the exclusion criteria were those who presented with psychotic disorders, bipolar mood disorder or a history of illicit drug.

Outcome measures: Participants were administered a self-reported questionnaire to gather data on demographic, personal, clinical and psychological characteristics; the 21-item depression, anxiety and stress scale (DASS-21) to assess the severity of their depressive, anxiety and stress symptoms; the multidimensional scale of perceived social support (MSPSS) to assess the degree of social support; and the World Health Organization quality of life-BREF (WHOQoL-BREF) to assess QoL.

Results: The psychological and social QoL scores were lower than the non-pandemic norms of the general population, while the physical health and environmental QoL scores were comparable. After adjusting for relevant demographic, personal, and clinical variables, religious coping; greater number of hours of online classes attended; and greater social support from family, friends and significant others were found to be significantly associated with higher QoL among the participants. Frustration because of study disruption, living in areas with a high prevalence of COVID-19 cases, and a higher severity of depressive and stress symptoms were significantly associated with lower QoL.

Conclusion: COVID-19 impaired the QoL of university students even after the movement lockdown was lifted.

Strengths and Limitations:

- This cross-sectional study recruited university students from northern and central part of Peninsular Malaysia to evaluate quality of life and determine its association with various factors and social support after the end of the movement lockdown.
- We identified the COVID-19 related stressors and coping, psychological factors and the source of social support which were significantly associated with the different domains of quality of life (physical health, psychological, social relationship and environmental quality of life) among university students after adjusting for relevant demographic, personal, and clinical variables.
- Based on the findings of this study, we can highlight a few recommendations to improve the QoL of university students during the COVID-19 pandemic.
- Data on quality of life among university students and its associated factors after the end of the movement lockdown is lacking despite their academic activities were greatly disrupted during the COVID-19 pandemic and the movement lockdown that followed.
- Due to the non-random sampling of the participants in this study, they may not be a representative sample of university students in Malaysia.

INTRODUCTION

The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is a highly infectious and contagious virus belonging to the coronavirus family. Since its announcement by the World Health Organization (WHO) as a global pandemic on 11 March 2020, it has caused a major health hazard globally—the coronavirus disease 2019 (COVID-19) pandemic.[1] Malaysia, which has been experiencing an alarming increase in the prevalence of COVID-19 since early March 2020, imposed a movement control order (MCO) throughout the entire country from March 2020 to June 2020. Under the MCO, all forms of public gatherings for social, religious, sporting, or cultural purposes were banned, and all places of worship and business premises except for essential services were closed.[2] The MCO was lifted in June 2020 but the rate of spread of COVID-19 in the country was not fully under control. Fear of being infected with COVID-19 and uncertainty about the future resulting from the socioeconomic downfall and academic disruption stemming from this global pandemic have enormous psychological effects on university students.[3-7]

Quality of life (QoL) has emerged as an important measure in psychiatric research because of its frequent use as an assessment and treatment outcome indicator. The WHO's quality of life-BREF (WHOQoL-BREF) is a QoL measuring tool that can be used to compare health-related QoL across a huge variety of conditions or illnesses; it is also used as a tool to indicate the outcome of various QoL interventions.[8] Several factors, such as gender, education environment, years of study, depression, and chronic illness have been identified as predictors of QoL in university students.[9] In the Malaysian context, despite the MCO was lifted in June 2020, all academic activities were still confined, in which all classes are still conducted online since April 2020 and university students were not permitted to access the university's facilities. These new norms in the academic setting in Malaysia disrupt the usual daily routine and academic progress among university students. To the best of our knowledge, to date, data on QoL assessment in university students in response to the COVID-19 pandemic are lacking, particularly after the end of movement lockdown. Hence, this study filled the research gap via the following activities: (1) evaluating the QoL of university students and (2) assessing the association between various psychological factors, social support, and QoL to identify significant predictors of QoL among university students while adjusting for demographic, personal and clinical factors during the uncertain time of the COVID-19 pandemic and after the movement lockdown was lifted.

METHODS

Study setting and participants

This cross-sectional online survey was conducted from 1 July 2020 to 21 July 2020, which was 3 weeks after the Malaysian government lifted the MCO (MCO was lifted on 11 June 2020). During the period of data collection, although the MCO had been lifted, the rate of spread of COVID-19 in the country was not fully under control, with the number of cumulative COVID-19 cases at 8840 cases and the number of deaths at 123 cases at the end of the data collection period.[10] The sample size was calculated based on the formula:

$n= [(Z_{1-\alpha/2} \times \sigma)/\Delta]^2$ (where n was the total estimated sample size, $Z_{1-\alpha/2}$ was the value represented the desired confidence interval in which confidence level selected was at 95% with a critical value of 1.96, σ was standard deviation which was 18.2 based on the QoL of the general population,[11] and Δ was precision with a value of 2.5). Hence, the estimated sample size needed was 243 subjects (after considering an additional 20% of sample loss). Recruitment of study participants was carried out by snowball sampling from the medical faculties of Malaysian public university students in Klang Valley at the Central of Peninsular Malaysia and in the states of Penang and Kelantan located at the northern region of Peninsular Malaysia. Initially, the online survey was disseminated to medical postgraduate students and they were told to circulate the invitation to participate in the survey to other medical postgraduate students, medical undergraduate students, postgraduate and undergraduate students in medical sciences and other students within the medical faculties of public Malaysian universities located at the targeted regions. We selected participants with a diverse range of demographic characteristics according to age, gender and marital status. The study was approved by the Human Research Ethics Committee of USM (USM/JEPeM/COVID19-21) and the Medical Research Committee of the Faculty of Medicine, UKM (UKMPPI/111/8/JEP-2020-370). Those who were 18 years and above, registered as students with the Faculty of Medicine of Malaysian public universities located in Klang Valley and the states of Penang and Kelantan in Peninsular Malaysia, were eligible to participate in the study. Those who presented with psychotic disorders, bipolar mood disorder or a history of illicit drug use were excluded from the study. All the participants provided informed consent, and they were assured of anonymity and data confidentiality. They completed the questionnaires through an online survey platform (Google Forms). Initially, a total of 381 participants responded to the online survey. We excluded 65 participants who took less than 60% of the median time to complete the questionnaires in this study (median time= 15 minutes) to avoid any response bias. Double responses from the

same participant were prevented by activating the "limiting responses to once per person" function in Google Forms. The final sample size of the study was 316 participants.

Data collection

A self-report questionnaire was administered to the participants to collect data on the following: demographic and personal characteristics, clinical factors, and COVID-19 related stressors and coping of the participants. The self-reported questionnaire was constructed based on previous surveys on the psychological impact of the SARS and MERS epidemics on university and medical students.[12-16] The participants were also administered the Malay version of the 21-item depression, anxiety and stress scale (DASS-21) to assess the severity of their depressive, anxiety and stress symptoms; the Malay version of the multidimensional scale of perceived social support (MSPSS) to assess the degree of social support; and the Malay version of the WHOQoL-BREF to assess QoL. In this study, the DASS-21 subscale scores, MSPSS domain scores and WHOQoL-BREF domain scores were presented as continuous variables.

Demographic characteristics

Data on demographic characteristics of the participants collected in this study included age, gender, marital status and monthly living expenses. The assessment and coding for demographic characteristics are summarized in Section 1 of the Supplementary material.

Personal characteristics

The personal characteristics assessed in this study were types of courses enrolled in university and living arrangement. The assessment and coding for personal characteristics are summarized in Section 1 of the Supplementary material.

Clinical factors

Data on two clinical factors were collected in this study, which were history of pre-existing medical illnesses and history of pre-existing depressive and anxiety disorders. The assessment and coding for clinical factors are summarized in Section 1 of the Supplementary material.

COVID-19 related stressors and coping

Data on COVID-19 related stressors and coping included in this study were hours of online classes attended per week, perceived prevalence of COVID-19 cases at place of living, frustration because of loss of daily routine, frustration because of disruption of study and use of religious coping to manage stress in response to the COVID-19 pandemic. The assessment and coding for COVID-19 related stressors and coping are summarized in Section 1 of the Supplementary material.

Depression, anxiety and stress

The presence of depression, anxiety and stress as well as the severity of these symptoms were evaluated with the DASS-21. The DASS-21 is a self-report questionnaire consisting of 21 items, with 7 items per subscale; the subscales are depression, anxiety and stress. Each item is scored on a Likert scale from 0 (did not apply to me at all) to 3 (applied to me very much). Sum scores are computed by adding the scores on the items per subscale and multiplying them by a factor of 2. Sum scores for each of the subscales may range between 0 and 42. Hence, the total score of the DASS-21 ranges from 0 to 120. The cut-off scores for case findings in DASS-21 are as follows: 9 for the depression subscale, 7 for the anxiety subscale and 14 for the stress subscale.[17] The Malay version of the DASS-21 has good Cronbach's alpha values of 0.75, 0.74 and 0.79 for the depression, anxiety and stress subscales, respectively.[18]

Social support

The perceived social support received from family, friends and significant others were measured by the MSPSS. The MSPSS is a self-administered instrument that measures the perceived adequacy of the available amount of social support individuals receive from friends, family and significant others/special persons. The MSPSS has 12 items, where each item is rated on a 7-point Likert scale ranging from 1 (very strongly disagree) to 7 (very strongly agree). Hence, the cumulative scores of the MSPSS range from 12 to 84. Each domain comprises four items; hence, the cumulative scores for each domain range from 4 to 28. The higher the score, the higher the level of perceived social support of the individual. The original version of the MSPSS has good internal consistency (Cronbach's $\alpha = 0.88$).[19] The Malay version of the MSPSS has been validated among Malaysian university students, showing a high internal consistency (Cronbach's $\alpha = 0.94$).[20]

Quality of life

The quality of life of the participants was measured by the WHOQoL-BREF. The WHOQoL-BREF is a self-administered questionnaire that was used to assess the QoL of the subjects. It comprises 26 items; items 1 and 2

are general questions on QoL, whereas the other items are grouped into four domains (i.e. physical health, psychological, social relationship and environment-related QoL. Each item is scored on a Likert scale ranging from 1 to 5. Each domain is scored with values from 0 to 100, with higher scores indicating better QoL. The WHOQoL-BREF has good psychometric properties.[21] The general norms for the WHOQoL-BREF domain scores are as follows: 70.6 (standard deviation = 14.0) for psychological QoL, 73.5 (standard deviation = 18.1) for physical health QoL, 75.1 (standard deviation = 13.0) for environmental QoL and 71.5 (standard deviation = 18.2) for social relationships QoL.[11] The Malay version of the WHOQoL-BREF has also demonstrated excellent psychometric properties, with an internal consistency (Cronbach's α) of 0.89.[22]

Statistical analysis

Statistical analyses were performed with the Statistical Package for Social Sciences (SPSS) version 26 (SPSS 26; SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were reported for demographic, personal, clinical factors and COVID-19 related stressors and coping of the participants, as well as for the DASS-21, MSPSS and WHOQoL-BREF domain scores (to achieve objective 1 of the study). All the categorical variables were presented as frequencies and percentages, while the continuous variables were presented as means and standard deviations. There were no missing data.

To achieve objective 2 of the study, simple and multiple linear regression analyses were used to examine the association between COVID-19 related stressors and coping, psychological factors, perceived social support and quality of life domains. In the multiple linear regression analyses, we adjusted relevant demographic, personal, and clinical variables. Multicollinearity was assessed by referring to the variance inflation factor, in which all the independent variables included in the multiple linear regression models had a score of < 5, indicating no multicollinearity. The normal probability plot of residuals of all the multiple linear regression models demonstrated that all the points lay in a reasonably straight diagonal line from bottom left to top right, indicating that the errors of the linear regression models were normally distributed. Statistical significance was set at $p < 0.05$ for the multiple linear regression analyses, and all p-values were two-sided.

RESULTS

Study participants

All the participants completed all the questionnaires. The demographic, personal, clinical characteristics and COVID-19 related stressors and coping of the participants are summarised in Table 1.

[Table 1 here]

The mean physical health QoL, psychological QoL, social relationship QoL and environment QoL scores were 75.31 (SD = 15.11), 67.72 (SD = 17.14), 68.32 (SD = 18.22) and 74.61 (SD = 13.68), respectively. The psychological characteristics, social support and QoL of the participants are presented in Table 1.

Associations between various factors and physical health related QoL among the participants

Table 2 illustrates the association between COVID-19 related stressors and coping, psychological characteristics, social support and physical health–related QoL among the participants. Simple linear regression revealed that several factors were significantly associated with physical health–related QoL, and these are listed in Table 3. However, the multiple linear regression model indicated that only three variables were significantly associated with higher physical health–related QoL, which were a greater number of hours of online classes attended per week (B = 0.291, 95% CI= 0.088 to 0.494, $p = 0.005$), higher family support (B = 2.300, 95% CI= 0.856 to 3.743, $p = 0.002$) and higher friend support (B =2.662, 95% CI= 1.219 to 4.104, $p < 0.001$). In contrast, presence of frustration because of study disruption (B = -4.493, 95% CI= -7.320 to -1.667, $p = 0.002$), and greater severity of stress symptoms (B = -0.302, 95% CI= -0.603 to -0.001, $p = 0.049$) were significantly associated with lower physical health–related QoL. The multiple linear regression model contributed to a significant regression equation of $F(19,296) = 16.793$, $p < 0.001$ with adjusted $R^2 = 0.488$.

[Table 2 here]

Association between various factors and psychological-related QoL among the participants

Table 3 presents the association between COVID-19 related stressors and coping, psychological characteristics, social support, and psychological-related QoL among the participants. Simple linear regression illustrated that several factors were significantly associated with psychological–related QoL, and these are listed in Table 4. The multiple linear regression model indicated that higher family support (B = 2.973, 95% CI= 1.631 to 4.315, *p*

< 0.001), higher friend support (B = 2.367, 95% CI= 1.027 to 3.708, $p = 0.001$) and higher significant other support (B = 2.134, 95% CI= 1.007 to 3.262, $p < 0.001$) were significantly associated with higher psychological-related QoL. Only two variables were significantly associated with lower psychological-related QoL, which were the perception that the area of residence had a high prevalence of COVID-19 cases (B = -3.046, 95% CI= -5.557 to -0.535, $p = 0.018$) and greater severity of depressive symptoms (B = -0.645, 95% CI= -0.897 to -0.393, $p < 0.001$). The multiple linear regression model contributed to a significant regression equation of $F(19,296) = 32.616$, $p < 0.001$ with adjusted $R^2 = 0.656$.

[Table 3 here]

Associations between various factors and social relationship QoL among the participants

The associations between COVID-19 stressors and coping, psychological characteristics, social support, and social relationship QoL among the participants are summarised in Table 4. Simple linear regression indicated that several factors were significantly associated with social relationship QoL, and these are listed in Table 5. Nevertheless, the multiple linear regression model showed that only agreement that religious coping helped manage stress (B =4.048, 95% CI= 0.798 to 7.299, $p = 0.015$), higher family support (B = 2.105, 95% CI= 0.383 to 3.827, $p = 0.017$), higher friend support (B = 5.307, 95% CI= 3.586 to 7.028, $p < 0.001$) and higher significant other support (B = 2.161, 95% CI= 0.714 to 3.608, $p = 0.004$) were significantly associated with higher social relationship QoL. None of the variables predicted lower social relationship QoL. The multiple linear regression model contributed to a significant regression equation of $F(19,296) = 17.500$, $p < 0.001$ with adjusted $R^2 = 0.499$.

[Table 4 here]

Associations between various factors and environment related QoL among the participants

The association between COVID-19 related stressors and coping, psychological characteristics, social support, and environment QoL among the participants are illustrated in Table 5. Simple linear regression revealed that several factors were significantly associated with environment QoL, and these are listed in Table 6. The multiple linear regression model confirmed that agreeing that religious coping helped to manage stress (B = 3.947, 95%

CI= 1.337 to 6.558, $p = 0.003$), higher family support (B = 1.801, 95% CI= 0.418 to 3.184, $p = 0.011$), higher friend support (B =3.101, 95% CI= 1.719 to 4.483, $p < 0.001$) and higher significant other support (B = 2.367, 95% CI= 1.205 to 3.529, $p < 0.001$) were significantly associated with higher environment QoL. None of the variables predicted lower environmental QoL. The multiple linear regression model contributed to a significant regression equation of $F(19,296) = 13.323$, $p < 0.001$ with adjusted $R^2 = 0.426$.

[Table 5 here]

DISCUSSION

This study investigated the QoL of Malaysian university students and its association with various factors and social supports at a time when the country is still battling the COVID-19 pandemic and after the end of movement lockdown. As a comparison to the norms of the WHOQoL-BREF domain scores in the non-pandemic affected general population,[11] the psychological ($67.72_{[study]}$ vs $70.6_{[general\ population]}$) and social relationship QoL levels ($68.32_{[study]}$ vs $71.5_{[general\ population]}$) reported in our study were relatively low, whereas the physical health and environment QoL levels were comparable. This finding was not surprising because the prevalence rates of depression, anxiety and stress among the participants in this study were 36%, 37% and 42%, respectively, which may lead to lower psychological QoL. Furthermore, the practice of social distancing and the restriction on organising and attending social activities as preventive measures to curb the spread of COVID-19 may contribute to lower social relationship QoL.

We found that only a greater number of hours of online classes attended per week and higher family and friend support significantly predicted an increase in physical health QoL among the participants. The literature pointed out that chronic absenteeism from class is associated with a higher risk of engaging in health risk behaviours, such as cigarette smoking, chronic alcohol use and risky sexual behaviours. In contrast, a sense of academic achievement is associated with a higher level of general health.[23,24] Hence, the finding that university students who attended a greater number of hours of classes had higher physical health QoL in this study was in line with what was described in the literature. For the relationship between family and friend support and physical health QoL, a survey of 2348 adults in the United States reported that having good friend networking and friend support predicted increases in good subjective health status. Conversely, family and friend relationship strain

may dampen long-term physical health.[25] In addition, greater family and friend support is related to increased moderate-and vigorous-intensity physical activity, which may enhance physical health–related QoL.[26,27] Although our study did not assess the amount of physical activity engaged in by participants during the COVID-19 pandemic, increasing physical activities, such as exercise at home with family and friends, may be helpful to cope with boredom and a loss of daily routine, potentially enhancing the physical health QoL of the participants. Our findings identified that frustration because of study disruption and higher severity of stress symptoms significantly predicted a decrease in physical health QoL of the participants. Interestingly, further questioning of the participants indicated that they were complaining of uncertainty about their future as their study was prolonged, their graduation time would be delayed as a result of the COVID-19 pandemic and they were disturbed by loss of their daily academic routine, such as their usual classes and clinical sessions. These difficulties experienced by the participants were associated with increased severity of stress symptoms in this study. In fact, high level of stress among university students, particularly medical students may lead to stress-related physical exhaustion which may impaired their physical health-related QoL.[28] Hence, our study findings further strengthened the link between higher severity of anxiety symptoms and lower physical health QoL.

Four factors were identified as significant predictors of higher psychological QoL, which were as follows: higher levels of 1) family, 2) friend and 3) significant other social support. Conversely, higher severity of depression and perception of living in an area with high prevalence of COVID-19 cases significantly predicted lowering of psychological QoL. Studies on the general population and healthcare workers during the spread of the COVID-19 pandemic pinpointed that higher social support was associated with lower anxiety and depression, whereas lower social support was associated with higher anxiety and depression.[29-33] Greater family and friend support, greater integration into a social network and having a larger social network are also protective against depression.[34] Higher family and friend support have also been shown to enhance psychological well-being.[35] Hence, it is not surprising that higher family, friend and significant other social support for the participants in this study was associated with higher psychological QoL. Our finding that those who perceived the area in which they lived to have a high prevalence of COVID-19 cases showed reduced psychological QoL is similar to the findings of two studies in China, which also reported that those who live and work in close proximity to the epicentre of COVID-19 infection had higher odds of experiencing psychological symptoms, such as depressive and posttraumatic stress disorder symptoms.[33,36] The tighter movement control and fear of contracting the COVID-19 infection (for the self and family) in those who perceived that they lived in an area with a high prevalence of COVID-19 cases may have led to the emergence of higher negative affect,

depreciating respondents' psychological QoL. Depression has been reported to diminish psychological QoL, and this is attributed to the mood disturbance experienced by the depressed person. The degree of decrement of psychological QoL is inversely proportional to the severity of depressive symptoms.[37] A study of 394 depressive disorder patients in Ethiopia reported that the psychological QoL domain of the WHOQoL-BREF score were as low as 42.8 ± 8.2.[38] Hence, our finding of the inverse relationship between depressive symptoms' severity and psychological QoL is well documented in the literature.

Our study indicated that using religious coping to manage their stress during the COVID-19 pandemic and having higher family, friend and significant other support predicted increased social relationship QoL among university students. No factors were significantly associated with lower social relationship QoL. Religious practices like attending religious services often increase the social network of attendees and allow frequent exchanges and sharing of information compared with attending such services less frequently.[39] It has been found that persons who attend religious services with one or both parents have greater promoted feelings of well-being, and those who attend religious services with their spouses exhibit enhanced relationship commitment.[40] Further questioning of the participants in our study revealed that those who attempted to cope with the MCO and COVID-19 pandemic with religious coping spent more time in prayers with family at home during the MCO; hence, they strengthened their family ties and enhanced their social relationship QoL further. These results may explain the reason behind our finding that those who utilised religious coping to manage stress reported better social relationship QoL. The COVID-19 pandemic has changed the quality of social relationships, where people receive more good support from their family, feel more caring towards family and others and share their feelings with others more often.[41] These shifts in social relationships support the association between higher family, friend and significant other support and greater social relationship QoL reported by the university students in this study.

The current study also highlighted that religious coping and greater family, friend and significant other support predicted an increase in the environmental QoL, while none of the COVID-19 related stressors and psychological complications were associated with lower environmental QoL among university students during the COVID-19 pandemic. Like our study, in which most participants were Muslim, Gardner et al. (2014) surveyed 114 Muslim university students in New Zealand and highlighted that religious coping was positively related with QoL.[42] Assessment of the individual domains of the WHOQoL-BREF also indicated that positive religious coping is associated with an increase in environmental QoL,[43] supporting our finding that religious coping increased environmental QoL. Greater family, friend and significant other social support allow persons

to strengthen their family ties, increase their social network size with friends and strengthen the positive relationship of a couple or partners. This may improve access of the person to resources and material goods, including financial support. Greater self-efficacy, competence and self-esteem as a result of good support from social networks may increase the sense of security of the physical surroundings and daily living, heightening environmental QoL.[44] Hence, it is not surprising that greater family, friend and significant other social support leads to higher environmental QoL, as reported by this study.

Based on the findings of this study, we can highlight a few recommendations to improve the QoL of university students during the COVID-19 pandemic. First, higher education institutions (HEIs) should pay more attention to students who live in areas where COVID-19 cases are highly prevalent because these groups of students may have impaired QoL. Second, several psychological factors were reported to dampen QoL in this study, such as frustration because of study disruption and higher severity of depressive and anxiety symptoms. During the COVID-19 pandemic, when social distancing is pivotal as an infection preventive measure, online psychosocial interventions that help curb these psychological complications are of utmost importance. Hence, HEIs should consider arranging online counselling or psychotherapy for university students needing these services. An example of an effective online psychosocial intervention for university students is the MePlusMe programme, which promotes psychological well-being, supports mood and daily functioning and enhances the study skills of university students.[45] Third, as religious coping and family, friend, and significant other social support increased the QoL of university students, HEIs and the government may focus on efforts to organise more online social support groups, encourage the use of web-conferencing applications to sustain social communication and relationships and organise more online religious talks through HEI websites during the COVID-19 pandemic. Finally, a sufficient duration of online classes should be arranged to enhance the sense of academic satisfaction and reduce feelings of uncertainty among university students, considering that a greater number of hours of online classes attended improve the QoL of university students.

There are a few limitations to take note of in this study. First, the cross-sectional design of this study did not allow the causal relationship between various factors and QoL to be determined across time. Second, as the participants were not sampled by random sampling, they may not be a representative sample of the university students in Malaysia. Despite these limitations, this study filled the research gap of the scarcity of data on QoL of university students after the movement lockdown ended and allowed several recommendations to be made.

CONCLUSION

In conclusion, this study indicated that university students had lower psychological and social relationship QoL levels in response to the COVID-19 pandemic even after the MCO was lifted. The current study identified two COVID related stressors which predicted lower QoL among university students: frustration because of study disruption and perception of living in an area with high prevalence of COVID-19 cases. Two psychological factors were predictive of lower QoL: higher severity of depression and stress. Conversely, greater number of hours of classes attended per week, religious coping, higher family, friends and significant others social support were associated with higher QoL among university students. Our findings indicated the pivotal role of online mental healthcare services and social support groups, and we made some recommendations to improve the QoL of university students during the COVID-19 pandemic.

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Conflicts of interest

All the authors declare no conflict of interest influencing the present work.

Author contributions

M.F.I.L.B.A involved in conceptualization of the research, data curation, obtained financial support, resources, investigation, methodology, data collection, data analysis and interpretation, supervision, validation, and writing of the original draft of the manuscript. N.S.M involved in data curation, investigation, methodology, data analysis and interpretation, and writing and editing of revised draft of the manuscript. S.H.T involved in investigation, data collection, data analysis and interpretation, and writing and editing of revised draft of the manuscript. M.A.M involved in data collection, data analysis and interpretation, and writing and editing of revised draft of the manuscript. All authors have reviewed and approved the final version of the manuscript before submission.

Patient consent

Patient consent for publication not required.

Ethical approval

Ethics approval This study was approved by the Human Research Ethics Committee of the Universiti Sains Malaysia with reference number: USM/JEPeM/COVID19-21 and the Medical Research Committee of the Faculty of Medicine, Universiti Kebangsaan Malaysia with reference number: UKMPPI/111/8/JEP-2020-370. Each participant provided written informed consent before participating in the study.

Availability of data and material

All the data has been included in the manuscript and the supplementary material file.

Supplementary material

Section 1: The questions for assessment of and coding of the demographic, personal, clinical, and psychological characteristics of the participants.

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Table 1. Demographic, personal, clinical characteristics, COVID-19 related stressors and coping, psychological characteristics, social support, and quality of life of the participants

Variables	n	%
Demographic characteristics:		
-Age:	29.51[#]	6.16[$]
- Gender:		
Male	95	30
Female	221	70
-Marital status:		
Married	126	40
Single/divorcee/widowed	190	60
-Living expenses spent per month:		
≤ Ringgit Malaysia 3000	196	62
> Ringgit Malaysia 3000	120	38
Personal characteristics:		
-Types of course enrolled in university:		
Medical science-based	69	22
Medicine-based	247	78
-Living arrangement:		
Live alone/with friends	50	16
Live with family	266	84
Clinical characteristics:		
-History of pre-existing medical illnesses:		
No	261	83
Yes	55	17
-History of pre-existing depressive and anxiety disorders:		
No	301	95
Yes	15	5

COVID-19 related stressors and coping:		
-Frustration due to loss of daily routine:		
No	177	56
Yes	139	44
-Mean hours of online classes attended per week		
-Frustration due to study disruption:	5.49[#]	3.45[$]
No	107	34
Yes	209	66
-Was your place of living highly prevalent for COVID-19 positive cases?		
No	222	70
Yes	94	30
-Religion helped you to cope with stress during COVID-19?		
No	101	32
Yes	215	68
Psychological characteristics:		
-Mean DASS-21 Depression Subscale score	8.53[#]	8.37[$]
-Mean DASS-21 Anxiety Subscale score	6.83[#]	7.98[$]
-Mean DASS-21 Stress Subscale score	10.52[#]	8.95[$]
Social support:		
-Mean family support score	22.28[#]	4.87[$]
-Mean friend support score	21.68[#]	4.72[$]
-Mean significant other support score	22.07[#]	9.16[$]
Quality of life:		
-Mean physical health QoL score	75.31[#]	15.11[$]
-Mean psychological QoL score	67.72[#]	17.14[$]
-Mean social QoL score	68.32[#]	18.22[$]
-Mean environment QoL score	74.61[#]	13.68[$]

[#] = mean, [$] = standard deviation

Table 2. The association between various factors and physical health-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-9.166 (-12.384 to -5.949)	< 0.001*	-2.455 (-5.216 to 0.305)	0.081
-Mean hours of online classes attended per week	0.240 (-0.014 to 0.493)	0.064	0.291 (0.088 to 0.494)	0.005*
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-8.367 (-11.783 to -4.952)	< 0.001*	-4.493 (-7.320 to -1.667)	0.002*
-Was your place of living highly prevalent for COVID-19 positive cases?				
No	Reference		Reference	
Yes	-3.647 (-7.289 to -0.005)	0.050	-2.076 (-4.778 to 0.625)	0.131
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	2.910 (-0.667 to 6.488)	0.110	1.942 (-0.783 to 4.667)	0.162
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-0.997 (-1.164 to -0.830)	< 0.001*	-0.062 (-0.333 to 0.209)	0.653
-Mean DASS-21 Anxiety Subscale score	-0.909 (-1.093 to -0.724)	< 0.001*	-0.251 (-0.535 to 0.034)	0.084

-Mean DASS-21 Stress Subscale score	-0.959 (-1.113 to -0.804)	< 0.001*	-0.302 (-0.603 to -0.001)	0.049*
Social support:				
-Mean family support score	6.284 (5.068 to 7.499)	< 0.001*	2.300 (0.856 to 3.743)	0.002*
-Mean friend support score	6.332 (5.102 to 7.561)	< 0.001*	2.662 (1.219 to 4.104)	< 0.001*
-Mean significant other support score	3.967 (2.836 to 5.098)	< 0.001*	0.216 (-0.997 to 1.429)	0.726

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(19,296) = 16.793$, $p < 0.001$ with adjusted $R^2 = 0.488$, adjusted for age, gender, marital status, living expenses, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Table 3. The association between various factors and psychological-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-9.321 (-13.006 to -5.637)	< 0.001*	-2.277 (-4.843 to 0.289)	0.082
-Mean hours of online classes attended per week	0.202 (-0.087 to 0.491)	0.170	0.147 (-0.041 to 0.335)	0.126
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-5.814 (-9.776 to -1.852)	0.004*	0.370 (-2.257 to 2.998)	0/782
-Was your place of living highly prevalent for COVID-19 positive cases?				
No	Reference		Reference	
Yes	-5.438 (-9.550 to -1.326)	0.010*	-3.046 (-5.557 to -0.535)	0.018*
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	5.212 (1.180 to 9.245)	0.011*	2.421 (-0.112 to 4.954)	0.061
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-1.440 (-1.601 to -1.278)	< 0.001*	-0.645 (-0.897 to -0.393)	< 0.001*
-Mean DASS-21 Anxiety Subscale score	-1.119 (-1.323 to -0.916)	< 0.001*	-0.181 (-0.446 to 0.083)	0.178

-Mean DASS-21 Stress Subscale score	-1.204 (-1.369 to -1.038)	< 0.001*	-0.121 (-0.401 to 0.159)	0.395
Social support:				
-Mean family support score	9.082 (7.854 to 10.311)	< 0.001*	2.973 (1.631 to 4.315)	< 0.001*
-Mean friend support score	8.500 (7.200 to 9.800)	< 0.001*	2.367 (1.027 to 3.708)	0.001*
-Mean significant other support score	6.744 (5.589 to 7.899)	< 0.001*	2.134 (1.007 to 3.262)	< 0.001*

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(19,296) = 32.616$, $p < 0.001$ with adjusted $R^2 = 0.656$, adjusted for age, gender, marital status, living expenses, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Table 4. The association between various factors and social relationship-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-7.319 (-11.306 to -3.332)	< 0.001*	-0.508 (-3.801 to 2.785)	0.762
-Mean hours of online classes attended per week	0.235 (-0.072 to 0.542)	0.133	0.199 (-0.043 to 0.441)	0.107
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-6.224 (-10.435 to -2.012)	0.004*	-2.511 (-5.882 to 0.861)	0.144
-Was your place of living highly prevalent for COVID-19 positive cases?				
No	Reference		Reference	
Yes	-2.973 (-7.379 to 1.433)	0.185	-1.763 (-4.985 to 1.459)	0.282
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	6.353 (2.080 to 10.627)	0.004*	4.048 (0.798 to 7.299)	0.015*
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-1.068 (-1.279 to -0.858)	< 0.001*	-0.114 (-0.437 to 0.210)	0.491
-Mean DASS-21 Anxiety Subscale score	-0.861 (-1.096 to -0.627)	< 0.001*	-0.190 (-0.529 to 0.150)	0.272

-Mean DASS-21 Stress Subscale score	-0.913 (-1.115 to -0.711)	< 0.001*	-0.067 (-0.426 to 0.292)	0.713
Social support:				
-Mean family support score	8.547 (7.149 to 9.945)	< 0.001*	2.105 (0.383 to 3.827)	0.017*
-Mean friend support score	9.576 (8.239 to 10.913)	< 0.001*	5.307 (3.586 to 7.028)	< 0.001*
-Mean significant other support score	6.895 (5.647 to 8.142)	< 0.001*	2.161 (0.714 to 3.608)	0.004*

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(19,296) = 17.500$, $p < 0.001$ with adjusted $R^2 = 0.499$, adjusted for age, gender, marital status, living expenses, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Table 5. The association between various factors and environmental-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-4.879 (-7.886 to -1.873)	0.002*	-1.399 (-4.043 to 1.246)	0.299
-Mean hours of online classes attended per week	0.281 (0.052 to 0.510)	0.016*	0.186 (-0.008 to 0.381)	0.060
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-4.390 (-7.556 to -1.223)	0.007*	-2.549 (-5.257 to 0.159)	0.065
-Was your place of living highly prevalent for COVID-19 positive cases?		\		
No	Reference		Reference	
Yes	-1.263 (-4.577 to 2.051)	0.454	0.614 (-1.973 to 3.202)	0.641
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	4.361 (1.146 to 7.576)	0.008*	3.947 (1.337 to 6.558)	0.003*
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-0.690 (-0.855 to -0.526)	< 0.001*	-0.097 (-0.357 to 0.163)	0.463
-Mean DASS-21 Anxiety Subscale score	-0.544 (-0.724 to -0.363)	< 0.001*	-0.259 (-0.532 to 0.013)	0.062

-Mean DASS-21 Stress Subscale score	-0.588 (-0.745 to -0.431)	< 0.001*	0.051 (-0.237 to 0.340)	0.726
Social support:				
-Mean family support score	5.658 (4.556 to 6.760)	< 0.001*	1.801 (0.418 to 3.184)	0.011*
-Mean friend support score	6.328 (5.255 to 7.400)	< 0.001*	3.101 (1.719 to 4.483)	< 0.001*
-Mean significant other support score	4.756 (3.792 to 5.719)	< 0.001*	2.367 (1.205 to 3.529)	< 0.001*

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(19,296) = 13.323$, $p < 0.001$ with adjusted $R^2 = 0.426$, adjusted for age, gender, marital status, living expenses, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Supplementary material

Section 1: The questions for assessment of and coding of the demographic, personal, clinical, and psychological characteristics of the participants

Demographic characteristics

The age of participants was recorded as a continuous variable. The gender of participants was categorized into males and females. The marital status was coded into two groups, such as "married" and "single, divorce, or widowed". Monthly living expenses was categorized into two groups, such as "≤ Ringgit Malaysia 3000" and "> Ringgit Malaysia 3000".

Personal characteristics

The responses to the types of course enrolled was reported in two groups: "medical science-based course" (Bachelor of Science, Master of Science and Doctorate degree) and "medicine-based course" (Bachelor of Medicine and Surgery, Master of Medicine and subspeciality training). The responses to living arrangement was coded as "living alone or living with friends" and "living with family".

Clinical factors

History of pre-existing medical illnesses was evaluated through the question, "Do you have history of any medical illnesses?" The responses were coded as "No" and "Yes". History of pre-existing depressive and anxiety disorders was evaluated through the question, "Do you have history of any depressive or anxiety disorders?" The responses were coded as "No" and "Yes".

COVID-19 related stressors and coping

Hours of online classes attended per week was reported as a continuous variable. Perceived prevalence of COVID-19 cases at the area of living was investigated through the question, "Was your place of living located in an area with high prevalence of COVID-19 positive cases?" The responses were coded as "No" and "Yes". Frustration due to loss of daily routine was reported through the question, "Did you feel frustrated during the movement control order because of loss of daily routine which you usually performed prior to the emergence of the COVID-19 pandemic?" The responses were coded as 'No' and 'Yes'. Frustration due to disruption of study was assessed through the question, "Did you feel frustrated during the movement control order because your study or academic activities were disrupted?" The responses were coded as 'No' and 'Yes'. The use of religious

coping in managing stress during the COVID-19 pandemic was recorded based on the question, 'Did religion help you to cope with stress during the COVID-19 pandemic?' The responses were coded as 'No' and 'Yes'.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1	
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	
Objectives	3	State specific objectives, including any prespecified hypotheses	4	
Methods				
Study design	4	Present key elements of study design early in the paper	5	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-8	
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5	
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8, section 1 of supplementary material	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8, section 1 of supplementary material	
Bias	9	Describe any efforts to address potential sources of bias	5-6	

Study size	10	Explain how the study size was arrived at	5

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	7
		© *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	9-11, Table 2 to 5
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-11, Table 2 to 5
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Quality of life and associated factors of university students during the COVID-19 pandemic: a cross-sectional study

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Complete List of Authors:	Leong Bin Abdullah, Mohammad Farris Iman; Universiti Sains Malaysia, Advanced Medical and Dental Institute Mansor, Nor; Advanced Medical and Dental Institute, Universiti Sains Malaysia, Lifestyle Science Cluster Mohamad, Mohd Afifuddin; Advanced Medical and Dental Institute, Universiti Sains Malaysia, Lifestyle Science Cluster Teoh, Soo Huat ; Advanced Medical and Dental Institute, Universiti Sains Malaysia, Lifestyle Science Cluster
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Quality of life and associated factors of university students during the COVID-19 pandemic: a cross-sectional study

Mohammad Farris Iman Leong Bin Abdullah[1]**, Nor Shuhada Murad[1], Mohd Afifuddin Mohamad[1], Soo Huat Teoh[1]

[1]Lifestyle Science Cluster, Advanced Medical and Dental Institute, Universiti Sains Malaysia, SAINS@BERTAM, 13200 Kepala Batas, Pulau Pinang, Malaysia

****Corresponding author:**

Mohammad Farris Iman Leong Bin Abdullah

Lifestyle Science Cluster

Advanced Medical and Dental Institute

Universiti Sains Malaysia

SAINS@BERTAM

13200 Kepala Batas

Pulau Pinang

Malaysia

Email: farris@usm.my

Tel: +604-5622482

Fax: +604-5622468

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ABSTRACT

Objectives: This study aimed to evaluate quality of life (QoL) and determine its association with various factors and social support amongst university students during the COVID-19 pandemic after the end of movement lockdown.

Design, setting and participants: This online, cross-sectional study recruited 316 participants. The inclusion criteria were students 18 years and above who were registered with the faculties of medicine at Malaysian public universities located in Klang Valley and the states of Penang and Kelantan in Peninsular Malaysia. The exclusion criteria were those who presented with psychotic disorders, bipolar mood disorder or a history of illicit drugs.

Outcome measures: Participants were administered a self-reported questionnaire to gather data on demographic, personal, clinical and psychological characteristics. The questionnaire comprised the 21-item depression, anxiety and stress scale (DASS-21), the multidimensional scale of perceived social support (MSPSS) and the World Health Organization quality of life-BREF (WHOQoL-BREF).

Results: The psychological and social QoL scores were lower than the non-pandemic norms of the general population, while the physical health and environmental QoL scores were comparable. After adjusting for relevant demographic, personal and clinical variables, religious coping, greater number of hours of online classes attended and greater social support from family, friends and significant others were significantly associated with higher QoL amongst the participants. Frustration because of study disruption, living in areas with a high prevalence of COVID-19 cases and a higher severity of depressive and stress symptoms were significantly associated with lower QoL.

Conclusion: COVID-19 impaired the QoL of university students even after the movement lockdown was lifted.

Strengths and Limitations

- Data on quality of life (QoL) assessment amongst university students in response to the COVID-19 pandemic are lacking, particularly after the end of movement lockdowns.
- Data regarding the association between COVID-19-related stressors, psychological complications (such as depression, anxiety and stress), social support and QoL amongst university students during the COVID-19 pandemic are also scarce.
- This online cross-sectional study filled the research gap by recruiting university students from the northern and central parts of Peninsular Malaysia to evaluate QoL and determine its association with various factors and social support after the end of the movement lockdown.
- The respondents in this study may not be representative of the university student population due to the non-probability sampling method employed in this study.
- The cross-sectional study design did not allow the causal relationship between various factors and QoL to be determined over time.

INTRODUCTION

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is a highly infectious and contagious virus of the coronavirus family. Since the World Health Organization (WHO) announced a global pandemic on 11 March 2020, it has caused a major global health hazard—the coronavirus disease 2019 (COVID-19) pandemic.[1] Malaysia, which has been experiencing an alarming increase in the prevalence of COVID-19 since early March 2020, imposed a movement control order (MCO) throughout the entire country from March to June 2020. Under the MCO, all forms of public gatherings for social, religious, sporting or cultural purposes were banned, and all places of worship and business premises except for essential services were closed.[2] The MCO was lifted in June 2020, but the rate of spread of COVID-19 in the country was not fully under control. Fear of being infected with COVID-19 and uncertainty about the future resulting from the socioeconomic downturn and academic disruption stemming from this global pandemic have had enormous psychological effects on university students.[3–7]

Quality of life (QoL) has emerged as an important measure in psychiatric research because of its frequent use as an assessment and treatment outcome indicator. The World Health Organization quality of life-BREF (WHOQoL-BREF) is a measurement tool that can be used to compare health-related QoL across many conditions and illnesses and to indicate the outcome of various QoL interventions.[8] As movement lockdown and social distancing became the new norm in the daily life of university students during the height of the COVID-19 pandemic, they contributed to significant reduction of the students' activities, which was positively correlated with considerable deterioration of overall QoL.[9] Hence, it is pivotal to investigate how the COVID-19 pandemic and the movement restrictions that followed affected the QoL of university students, as deterioration of QoL can contribute to diminished academic performance.[10] Several factors, such as gender, education environment, years of study, depression and chronic illness have been identified as predictors of QoL in university students.[11] In Malaysia, although the MCO was lifted in June 2020, all academic activities were still restricted, all classes have still been conducted online since April 2020 and university students have not been permitted to access the university's facilities. These new norms in the academic setting in Malaysia have disrupted the usual daily routine and academic progress amongst university students, who are the main stakeholders of higher education. This inevitable consequence of the COVID-19 pandemic may have had a considerable impact on university students' QoL. To the best of our knowledge, data on QoL assessment in

university students in response to the COVID-19 pandemic are lacking, particularly after the end of movement lockdown. Moreover, data regarding the association between COVID-19-related stressors, psychological complications (such as depression, anxiety and stress), social support and QoL amongst university students during the COVID-19 pandemic is scarce. Hence, this study filled the research gap as follows: (1) evaluating the QoL of university students and (2) assessing the association between various psychological factors, social support and QoL to identify significant predictors of QoL amongst university students while adjusting for demographic, personal and clinical factors during the uncertain time of the COVID-19 pandemic and after the lifting of the movement lockdown.

METHODS

Study setting and participants

This cross-sectional online survey was conducted from 1 July to 21 July 2020, which was 3 weeks after the Malaysian government lifted the MCO on 11 June 2020. During the data collection period, although the MCO had been lifted, the rate of spread of COVID-19 in the country was not fully under control, with the number of cumulative COVID-19 cases at 8840 cases and the number of deaths at 123 cases at the end of the data collection period.[12] The data analysed in this study was partly based on the data from a cross-sectional survey of depression, anxiety, and their associated factors amongst university students in Malaysia during the COVID-19 pandemic. The sample size was calculated based on the formula $n = [(Z_{1-\alpha/2} \times \sigma)/\Delta]^2$ (where n was the total estimated sample size, $Z_{1-\alpha/2}$ was the value representing the desired confidence interval in which the confidence level selected was at 95% with a critical value of 1.96, σ was the standard deviation which was 18.2 based on the QoL of the general population[13] and Δ was precision with a value of 2.5). Hence, the estimated sample size needed was 243 subjects (after considering an additional 20% sample loss). The study participants were recruited by snowball sampling from the medical faculties of Malaysian public university students in Klang Valley in central Peninsular Malaysia and in the states of Penang and Kelantan located in the northern region of Peninsular Malaysia. The online survey was initially disseminated to medical postgraduate students, who were asked to circulate the invitation to participate in the survey to other medical postgraduate students, medical undergraduate students, postgraduate and undergraduate students in medical sciences and other students from the medical faculties of public Malaysian universities located in the targeted regions. We selected participants with a diverse range of demographic characteristics according to age, gender and marital status. The study was

approved by the Human Research Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/COVID19-21) and the Medical Research Committee of the Faculty of Medicine, Universiti Kebangsaan Malaysia (UKMPPI/111/8/JEP-2020-370). Those who were 18 years and above and registered as students with the faculties of medicine of the Malaysian public universities located in Klang Valley and the states of Penang and Kelantan in Peninsular Malaysia were eligible to participate. Those who presented with psychotic disorders, bipolar mood disorder or a history of illicit drug use were excluded from the study because these illnesses may lead to impaired mental capacity to answer questionnaires, since people with these illnesses may present with psychotic symptoms, manic features, and cognitive deficit. All the participants provided informed consent, and they were assured of anonymity and data confidentiality. They completed the questionnaires through an online survey platform (Google Forms). A total of 381 participants responded to the online survey. We excluded 65 participants who took less than 60% of the median time to complete the questionnaires in this study (median time = 15 minutes) to avoid any response bias. Double responses from the same participant were prevented by activating the 'limiting responses to once per person' function in Google Forms. The final sample size was 316 participants.

Data collection

A self-report questionnaire was administered to the participants to collect data on the following: demographic and personal characteristics, clinical factors and the participants' COVID-19-related stressors and coping mechanisms. The coding of the responses to the demographic and personal characteristics, clinical factors and the participants' COVID-19-related stressors and coping are presented in supplementary file 1. The self-reported questionnaire was constructed based on previous surveys on the psychological impact of the severe acute respiratory syndrome and Middle East respiratory syndrome epidemics on university and medical students.[14–18] We included the self-reported questionnaire in supplementary file 2. The participants were also administered the Malay version of the 21-item depression, anxiety and stress scale (DASS-21), the Malay version of the multidimensional scale of perceived social support (MSPSS), and the Malay version of the World Health Organization quality of life-BREF (WHOQoL-BREF). In this study, the DASS-21 subscale scores, MSPSS domain scores and WHOQoL-BREF domain scores were presented as continuous variables.

Demographic characteristics

Data on the participants' demographic characteristics included age, gender, marital status and monthly living expenses. The assessment and coding of demographic characteristics are summarised in supplementary file 1.

Personal characteristics

The personal characteristics assessed in this study were the types of courses enrolled in at university, the level of study which the respondents were enrolled in at university and living arrangements. The assessment and coding of personal characteristics are summarised in supplementary file 1.

Clinical factors

Data on two clinical factors were collected in this study: history of pre-existing medical illnesses and history of pre-existing depressive and anxiety disorders. The assessment and coding of clinical factors are summarised in supplementary file 1.

COVID-19-related stressors and coping mechanisms

Data on the COVID-19-related stressors and coping mechanisms included in this study were hours of online classes attended per week, perceived prevalence of COVID-19 cases at place of residence, frustration because of loss of daily routine, frustration because of disruption of study and use of religious coping to manage stress in response to the COVID-19 pandemic. The assessment and coding for COVID-19-related stressors and coping mechanisms are summarised in supplementary file 1.

Depression, anxiety and stress

The presence of depression, anxiety and stress and the severity of these symptoms were evaluated with the 21-item depression, anxiety and stress scale (DASS-21), which is a self-report questionnaire comprising 7 items per subscale; the subscales are depression, anxiety and stress. Each item was scored on a Likert scale from 0 (did not apply to me at all) to 3 (applied to me very much). The sum scores were computed by adding the scores on the items per subscale and multiplying them by a factor of 2. The sum scores for each subscale may range between 0 and 42. Hence, the total score of the DASS-21 ranges from 0 to 120. The cut-off DASS-21 scores for defining cases are 9 for the depression subscale, 7 for the anxiety subscale and 14 for the stress subscale.[19] The Malay version of the DASS-21 has good Cronbach's α values of 0.75, 0.74 and 0.79 for the depression, anxiety and stress subscales, respectively.[20]

Social support

The perceived social support was measured by the multidimensional scale of perceived social support (MSPSS), which is a self-administered instrument that measures the perceived adequacy of social support individuals

receive from friends, family and significant others/special persons. The MSPSS has 12 items, and each item was rated on a 7-point Likert scale ranging from 1 (very strongly disagree) to 7 (very strongly agree). The cumulative scores of the MSPSS range from 12 to 84. Each domain comprises 4 items, and the cumulative scores for each domain range from 4 to 28. The higher the score, the higher the individual's level of perceived social support of the individual. The original version of the MSPSS has good internal consistency (Cronbach's $\alpha = 0.88$).[21] The Malay version of the MSPSS has been validated amongst Malaysian university students, showing a high internal consistency (Cronbach's $\alpha = 0.94$).[22]

Quality of life

The QoL of the participants was measured using the World Health Organization quality of life-BREF (WHOQoL-BREF), which is a self-administered questionnaire used to assess QoL. It comprises 26 items: items 1 and 2 are general questions on QoL, and the other items are grouped into 4 domains (physical health and psychological, social relationship and environment-related QoL). Each item is scored on a Likert scale ranging from 1 to 5. Each domain was scored with values from 0 to 100, with higher scores indicating better QoL. The WHOQoL-BREF has good psychometric properties.[23] The general norms for the WHOQoL-BREF domain scores are as follows: 73.5 (standard deviation [SD] = 18.1) for physical health QoL, 70.6 (SD = 14.0) for psychological QoL, 71.5 (SD = 18.2) for social relationship QoL and 75.1 (SD = 13.0) for environmental QoL.[13] The Malay version of the WHOQoL-BREF has demonstrated excellent psychometric properties, with an internal consistency (Cronbach's α) of 0.89.[24]

Statistical analysis

Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 26 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were reported for the participants' demographic, personal and clinical factors and COVID-19-related stressors and coping mechanisms, as well as for the DASS-21, MSPSS and WHOQoL-BREF domain scores (to achieve objective 1 of the study). All the categorical variables were presented as frequencies and percentages, while the continuous variables were presented as means and standard deviations. There were no missing data.

To achieve objective 2 of the study, simple and multiple linear regression analyses were used to examine the association between COVID-19-related stressors and coping mechanisms, psychological factors, perceived social support and QoL domains. In the multiple linear regression analyses, we adjusted for relevant

demographic, personal and clinical variables. Multicollinearity was assessed by referring to the variance inflation factor, in which all the independent variables included in the multiple linear regression models had a score of <5, indicating no multicollinearity. The normal probability plot of the residuals of all the multiple linear regression models demonstrated that all the points lay in a reasonably straight diagonal line from bottom left to top right, indicating that the errors of the linear regression models were normally distributed. Statistical significance was set at p <0.05 for the multiple linear regression analyses, and all the p-values were two-sided.

Patient and public involvement

This study was conducted without involvement of the participants, patients and the public. The findings of the study will be disseminated to the participants via email upon request.

RESULTS

Study participants

All the participants completed the questionnaire. The demographic, personal, clinical characteristics, COVID-19-related stressors and coping mechanisms of the participants are summarised in Table 1.

[Table 1 here]

The mean physical health, psychological, social relationship and environment QoL scores were 75.31 (SD = 15.11), 67.72 (SD = 17.14), 68.32 (SD = 18.22) and 74.61 (SD = 13.68), respectively. The psychological characteristics, social support and QoL of the participants are presented in Table 1.

Association between various factors and physical health-related QoL

Table 2 illustrates the associations between COVID-19-related stressors and coping mechanisms, psychological characteristics, social support and physical health-related QoL amongst the participants. Simple linear regression revealed that several factors were significantly associated with physical health-related QoL (Table 2). However, the multiple linear regression model indicated that only three variables were significantly associated with higher physical health-related QoL: a greater number of hours of online classes attended per week (B = 0.287, 95% CI = 0.083 to 0.491, p = 0.006), higher family support (B = 2.294, 95% CI = 0.848 to 3.740, p = 0.002) and higher friend support (B = 2.660, 95% CI = 1.216 to 4.105, p <0.001). In contrast, frustration

because of study disruption (B = -4.483, 95% CI = -7.35 to -1.652, $p = 0.002$) and greater severity of stress symptoms (B = -0.299, 95% C I= -0.601 to -0.003, $p = 0.049$) were significantly associated with lower physical health-related QoL. The multiple linear regression model contributed to a significant regression equation of $F(20,295) = 15.912$, $p < 0.001$ with $R^2 = 0.519$.

[Table 2 here]

Association between various factors and psychological-related QoL

Table 3 presents the association between COVID-19-related stressors and coping mechanisms, psychological characteristics, social support and psychological-related QoL amongst the participants. Simple linear regression illustrated that several factors were significantly associated with psychological-related QoL, and these are listed in Table 3. The multiple linear regression model indicated that higher family support (B = 2.978, 95% CI = 1.633 to 4.322, $p <0.001$), higher friend support (B = 2.369, 95% CI = 1.026 to 3.712, $p = 0.001$) and higher significant other support (B = 2.133, 95% CI = 1.004 to 3.263, $p <0.001$) were significantly associated with higher psychological-related QoL. Only two variables were significantly associated with lower psychological-related QoL: the perception that the area of residence had a high prevalence of COVID-19 cases (B = -3.112, 95% CI = -5.658 to -0.566, $p = 0.017$) and greater severity of depressive symptoms (B = -0.645, 95% CI = -0.898 to -0.393, $p <0.001$). The multiple linear regression model contributed to a significant regression equation of $F(20,295) = 30.897$, $p <0.001$ with $R^2 = 0.677$.

[Table 3 here]

Associations between various factors and social relationship QoL

The associations between COVID-19 stressors and coping mechanisms, psychological characteristics, social support and social relationship QoL amongst the participants are summarised in Table 4. Simple linear regression indicated that several factors were significantly associated with social relationship QoL, and these are listed in Table 4. Nevertheless, the multiple linear regression model showed that only agreement that religious coping helped manage stress (B = 4.013, 95% CI = 0.758 to 7.267, $p = 0.016$), higher family support (B = 2.091, 95% CI = 0.367 to 3.815, $p = 0.018$), higher friend support (B = 5.304, 95% CI = 3.582 to 7.026, $p <0.001$) and higher significant other support (B = 2.164, 95% CI = 0.716 to 3.612, $p = 0.004$) were significantly associated with higher social relationship QoL. None of the variables predicted lower social relationship QoL. The multiple

linear regression model contributed to a significant regression equation of $F(20,295) = 16.624$, $p < 0.001$ with $R^2 = 0.530$.

[Table 4 here]

Associations between various factors and environment-related QoL

The association between COVID-19-related stressors and coping mechanisms, psychological characteristics, social support and environmental QoL amongst the participants are illustrated in Table 5. Simple linear regression revealed that several factors were significantly associated with environmental QoL, as listed in Table 5. The multiple linear regression model confirmed that agreeing that religious coping helped to manage stress (B = 3.930, 95% CI = 1.315 to 6.545, $p = 0.003$), higher family support (B = 1.794, 95% CI = 0.409 to 3.179, $p = 0.011$), higher friend support (B = 3.100, 95% CI = 1.716 to 4.483, $p < 0.001$) and higher significant other support (B = 2.369, 95% CI = 1.205 to 3.532, $p < 0.001$) were significantly associated with higher environment QoL. None of the variables predicted a lower environmental QoL. The multiple linear regression model contributed to a significant regression equation of $F(20,295) = 12.631$, $p < 0.001$ with $R^2 = 0.425$.

[Table 5 here]

DISCUSSION

This study investigated the QoL of Malaysian university students and its association with various factors and social supports when the country was still battling the COVID-19 pandemic and after the end of movement lockdown. As a comparison to the norms of the WHOQoL-BREF domain scores in the non-pandemic-affected general population,[13] the psychological ($67.72_{[study]}$ vs $70.6_{[general\ population]}$) and social relationship QoL levels ($68.32_{[study]}$ vs $71.5_{[general\ population]}$) reported in our study were relatively low, whereas the physical health and environment QoL levels were comparable. This finding was not surprising because the prevalence rates of depression, anxiety and stress amongst the participants in this study were 36%, 37% and 42%, respectively, which may have led to lower psychological QoL. Furthermore, social distancing and the restriction on organising and attending social activities as preventive measures to curb the spread of COVID-19 may have contributed to lower social relationship QoL.

We found that only a greater number of hours of online classes attended per week and higher family and friend support significantly predicted an increase in physical health QoL amongst the participants. The literature points

out that chronic absenteeism from class is associated with a higher risk of engaging in health risk behaviours, such as cigarette smoking, chronic alcohol use and risky sexual behaviours. In contrast, a sense of academic achievement is associated with a higher level of general health.[25,26] Hence, the finding that university students who attended a greater number of hours of classes had a higher physical health QoL in this study is in line with what has been described in the literature. For the relationship between family and friend support and physical health QoL, a survey of 2348 adults in the United States reported that having good friend networks and friend support predicted increases in good subjective health status. Conversely, family and friend relationship strain may decrease long-term physical health.[27] In addition, greater family and friend support is related to increased moderate and vigorous intensity physical activity, which may enhance physical health-related QoL.[28,29] Although our study did not assess participants' physical activity during the COVID-19 pandemic, increasing physical activity, such as exercising at home with family and friends, may help people to cope with boredom and a loss of daily routine, potentially enhancing physical health QoL. Our findings identified that frustration because of study disruption and higher severity of stress symptoms significantly predicted a decrease in the participants' physical health QoL. Interestingly, further questioning of the participants indicated that they were complaining of uncertainty about their future as their study was prolonged, their graduation time would be delayed as a result of the COVID-19 pandemic and they were disturbed by loss of their daily academic routine, such as their usual classes and clinical sessions. Moreover, a switch from conventional in-person or classroom teaching to the new norm of tele-education or online classes may have disrupted the academic momentum of university students, particularly medical students in vulnerable groups, such as those with financial difficulties and students living in rural or remote areas of the country. Such students may have experienced lack of internet access, problems with internet coverage and financial constraints that forced them to take up jobs to sustain them during the trying times of COVID-19, which may have hampered their commitment to adapt to the new norm of online learning.[30] The difficulties experienced by the participants were associated with increased severity of stress symptoms. High levels of stress amongst university students, particularly medical students, may lead to stress-related physical exhaustion that may impair their physical health-related QoL.[31] Hence, our study findings further strengthen the link between higher severity of anxiety symptoms and lower physical health QoL.

Four factors were identified as significant predictors of higher psychological QoL: higher levels of 1) family, 2) friend and 3) significant other social support. Conversely, both higher severity of depression and perception of living in an area with a high prevalence of COVID-19 cases significantly predicted lower psychological QoL.

Studies on the general population and healthcare workers during the COVID-19 pandemic have pinpointed that higher social support was associated with lower anxiety and depression, whereas lower social support was associated with higher anxiety and depression.[32–36] Greater family and friend support, greater integration into a social network and having a larger social network are also protective against depression.[37] Higher family and friend support have also been shown to enhance psychological well-being.[38] Hence, it is not surprising that higher family, friend and significant other social support for the participants in this study was associated with higher psychological QoL. Our finding that those who perceived the area in which they lived to have a high prevalence of COVID-19 cases showed reduced psychological QoL is similar to the findings of two studies in China, which reported that those living and working in close proximity to the epicentre of COVID-19 infection had higher odds of experiencing psychological symptoms such as depressive and posttraumatic stress disorder symptoms.[36,39] The tighter movement control and fear of contracting COVID-19 (for self and family) in those who perceived that they lived in an area with a high prevalence of COVID-19 cases may have led to the emergence of higher negative affect, depreciating respondents' psychological QoL. Depression has been reported to diminish psychological QoL, which is attributed to the mood disturbance experienced by the depressed person. The degree of decrement of psychological QoL is inversely proportional to the severity of depressive symptoms.[40] A study of 394 depressive disorder patients in Ethiopia reported that the psychological QoL domain of the WHOQoL-BREF score was as low as 42.8 ± 8.2.[41] Hence, our finding of the inverse relationship between depressive symptoms' severity and psychological QoL is well documented in the literature.

Our study indicated that using religious coping to manage stress during the COVID-19 pandemic and having higher family, friend and significant other support predicted increased social relationship QoL amongst the university students. No factors were significantly associated with lower social relationship QoL. Religious practices like attending religious services often increase attendees' social networks and allow frequent exchanges and sharing of information compared with attending such services less frequently.[42] It has been found that persons who attend religious services with one or both parents have greater promoted feelings of well-being, and those who attend religious services with their spouses exhibit enhanced relationship commitment.[43] Further questioning of the participants in our study revealed that those who attempted to cope with the MCO and COVID-19 pandemic with religious coping spent more time in prayers with family at home during the MCO; hence, they strengthened their family ties and further enhanced their social relationship QoL. These results may explain the reason behind our finding that those who utilised religious coping to manage stress reported better social relationship QoL. The COVID-19 pandemic has changed the quality of social

relationships, in that people receive better support from their family, feel more caring towards family and others and share their feelings with others more often.[44] These shifts in social relationships support the association between higher family, friend and significant other support and greater social relationship QoL reported by the university students in this study.

The current study also highlighted that religious coping and greater family, friend and significant other support predicted an increase in environmental QoL, while none of the COVID-19-related stressors and psychological complications were associated with lower environmental QoL amongst university students during the COVID-19 pandemic. Similar to our study, in which most participants were Muslim, Gardner et al. (2014) surveyed 114 university students in New Zealand and highlighted that religious coping was positively related with QoL.[45] Assessment of the individual domains of the WHOQoL-BREF also indicated that positive religious coping is associated with an increase in environmental QoL,[46] supporting our finding that religious coping increased environmental QoL. Greater family, friend and significant other social support allows persons to strengthen their family ties, increase their social network size with friends and strengthen the positive relationship of a couple or partners. This may improve access of the person to resources and material goods, including financial support. Greater self-efficacy, competence and self-esteem as a result of good support from social networks may increase the sense of security in relation to physical surroundings and daily living, heightening environmental QoL.[47] Hence, it is not surprising that greater family, friend and significant other social support leads to higher environmental QoL, as reported by this study.

Based on the findings of this study, we can highlight a few recommendations to improve the QoL of university students during the COVID-19 pandemic. First, higher education institutions (HEIs) should pay more attention to students who live in areas where COVID-19 cases are highly prevalent, because these groups of students may have impaired QoL. Second, several psychological factors were reported to decrease QoL in this study, such as frustration because of study disruption and a higher severity of depressive and anxiety symptoms. During the COVID-19 pandemic, when social distancing is pivotal as an infection preventive measure, online psychosocial interventions that help curb these psychological complications are of utmost importance. Hence, HEIs should consider arranging online counselling or psychotherapy for university students needing these services. An example of an effective online psychosocial intervention for university students is the MePlusMe programme, which promotes psychological well-being, supports mood and daily functioning and enhances university students' study skills.[48] Third, as religious coping and family, friend and significant other social support increased the QoL of university students, HEIs and the government should focus on efforts to organise more

online social support groups, encourage the use of web-conferencing applications to sustain social communication and relationships and organise more online religious talks through HEI websites during the COVID-19 pandemic. Finally, a sufficient duration of online classes should be arranged to enhance the sense of academic satisfaction and reduce feelings of uncertainty amongst university students, considering that a greater number of hours of online classes attended improves the QoL of university students. However, the question of whether COVID-19-related stressors have an impact on the academic performance of university students is still unresolved. To date, few studies have investigated how COVID-19 has affected the academic performance of college students, and the findings were inconsistent.[10,49] Despite this shortfall, several factors may be associated with better academic performance during the COVID-19 pandemic, such as better understanding of students' expectations amongst university instructors, feedback from students after completion of an online class, effective course design according to students' needs and higher degree of happiness amongst students.[50,51]

There are a few limitations to note in this study. First, the cross-sectional design of this study did not allow the causal relationship between various factors and QoL to be determined across time. Second, as the participants were not randomly sampled, they may not be representative of university students in Malaysia, hence this may restrict the generalisability of the findings. Third, as the questionnaires were all in the Malay language, it may have led to selection bias, as international students could not participate. However, most international students in Malaysia are enrolled in private HEIs rather than in public universities.[52] In addition, excluding respondents who took less than 60% of the median time of the sample to answer the online questionnaires may also lead to selection bias. Finally, we did not assess the socioeconomic background of the respondents in this study, which could be an important confounding factor. Students from lower socioeconomic backgrounds may have poor internet access and live in unfavourable living conditions, which may diminish their QoL during the COVID-19 pandemic.[30,53] Despite these limitations, this study fills the research gap of the scarcity of data on QoL of university students after the movement lockdown ended and has allowed several recommendations to be made.

CONCLUSION

In conclusion, this study indicated that university students had lower psychological and social relationship QoL levels in response to the COVID-19 pandemic, even after the MCO was lifted. The current study identified two COVID-related stressors that predicted lower QoL amongst university students: frustration because of study disruption and perception of living in an area with a high prevalence of COVID-19 cases. Two psychological

factors were predictive of lower QoL: higher severity of depression and stress. Conversely, the greater number of hours of classes attended per week, religious coping, higher family, friends and significant other social support were associated with higher QoL amongst university students. Our findings indicate the pivotal role of online mental health care services and social support groups, and we have made some recommendations to improve the QoL of university students during the COVID-19 pandemic.

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Author contributions

M.F.I.L.B.A involved in conceptualization of the research, data curation, obtained financial support, resources, investigation, methodology, data collection, data analysis and interpretation, supervision, validation, and writing of the original draft of the manuscript. N.S.M involved in data curation, investigation, methodology, data analysis and interpretation, and writing and editing of revised draft of the manuscript. S.H.T involved in investigation, data collection, data analysis and interpretation, and writing and editing of revised draft of the manuscript. M.A.M involved in data collection, data analysis and interpretation, and writing and editing of revised draft of the manuscript. All authors have reviewed and approved the final version of the manuscript before submission.

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Conflicts of interest

All the authors declare no conflict of interest influencing the present work.

Patient consent

Patient consent for publication not required.

Provenance and peer review

Not commissioned; externally peer-reviewed.

Ethical approval

Ethics approval This study was approved by the Human Research Ethics Committee of the Universiti Sains Malaysia with reference number: USM/JEPeM/COVID19-21 and the Medical Research Committee of the Faculty of Medicine, Universiti Kebangsaan Malaysia with reference number: UKMPPI/111/8/JEP-2020-370. Each participant provided written informed consent before participating in the study.

Availability of data and material

All the data has been included in the manuscript and the supplementary material files.

Supplementary materials

Supplementary file 1: The questions for assessment of and coding of the demographic, personal, clinical, and psychological characteristics of the participants

Supplementary file 2: Socio-demographic, COVID-19 related and clinical characteristics questionnaire (English and Malay versions)

ORCID iDs

Mohammad Farris Iman Leong Bin Abdullah https://orcid.org/0000-0002-7762-4052

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Table 1. Demographic, personal, clinical characteristics, COVID-19 related stressors and coping, psychological characteristics, social support, and quality of life of the participants

Variables	n	%
Demographic characteristics:		
-Age:	29.51[#]	6.16[$]
- Gender:		
Male	95	30
Female	221	70
-Marital status:		
Married	126	40
Single/divorcee/widowed	190	60
-Living expenses spent per month:		
≤ Ringgit Malaysia 3000	196	62
> Ringgit Malaysia 3000	120	38
Personal characteristics:		
-Level of study which the respondents were enrolled in at university:		
Undergraduate course	138	44
Postgraduate course	178	56
-Types of course enrolled in university:		
Medical science-based	69	22
Medicine-based	247	78
-Living arrangement:		
Live alone/with friends	50	16
Live with family	266	84
Clinical characteristics:		
-History of pre-existing medical illnesses:		
No	261	83
Yes	55	17

-History of pre-existing depressive and anxiety disorders:		
No	301	95
Yes	15	5
COVID-19 related stressors and coping:		
-Frustration due to loss of daily routine:		
No	177	56
Yes	139	44
-Mean hours of online classes attended per week	5.49[#]	3.45[$]
-Frustration due to study disruption:		
No	107	34
Yes	209	66
-Was your place of living highly prevalent for COVID-19 positive cases?		
No	222	70
Yes	94	30
-Religion helped you to cope with stress during COVID-19?		
No	101	32
Yes	215	68
Psychological characteristics:		
-Mean DASS-21 Depression Subscale score	8.53[#]	8.37[$]
-Mean DASS-21 Anxiety Subscale score	6.83[#]	7.98[$]
-Mean DASS-21 Stress Subscale score	10.52[#]	8.95[$]
Social support:		
-Mean family support score	22.28[#]	4.87[$]
-Mean friend support score	21.68[#]	4.72[$]
-Mean significant other support score	22.07[#]	9.16[$]
Quality of life:		
-Mean physical health QoL score	75.31[#]	15.11[$]

-Mean psychological QoL score	67.72[#]	17.14[$]
-Mean social QoL score	68.32[#]	18.22[$]
-Mean environment QoL score	74.61[#]	13.68[$]

[#] = mean, [$] = standard deviation

Table 2. The association between various factors and physical health-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-9.166 (-12.384 to -5.949)	< 0.001*	-2.544 (-5.354 to 0.266)	0.076
-Mean hours of online classes attended per week	0.240 (-0.014 to 0.493)	0.064	0.287 (0.083 to 0.491)	0.006*
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-8.367 (-11.783 to -4.952)	< 0.001*	-4.483 (-7.315 to -1.652)	0.002*
-Was your place of living highly prevalent for COVID-19 positive cases?				
No	Reference		Reference	
Yes	-3.647 (-7.289 to -0.005)	0.050	-2.001 (-4.740 to 0.738)	0.152
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	2.910 (-0.667 to 6.488)	0.110	1.928 (-0.803 to 4.658)	0.166
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-0.997 (-1.164 to -0.830)	< 0.001*	-0.062 (-0.334 to 0.210)	0.654
-Mean DASS-21 Anxiety Subscale score	-0.909 (-1.093 to -0.724)	< 0.001*	-0.254 (-0.540 to 0.031)	0.081

-Mean DASS-21 Stress Subscale score	-0.959 (-1.113 to -0.804)	< 0.001*	-0.299 (-0.601 to -0.003)	0.049*
Social support:				
-Mean family support score	6.284 (5.068 to 7.499)	< 0.001*	2.294 (0.848 to 3.740)	0.002*
-Mean friend support score	6.332 (5.102 to 7.561)	< 0.001*	2.660 (1.216 to 4.105)	< 0.001*
-Mean significant other support score	3.967 (2.836 to 5.098)	< 0.001*	0.217 (-0.997 to 1.432)	0.725

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(20,295) = 15.912$, $p < 0.001$ with $R^2 = 0.519$, adjusted for age, gender, marital status, living expenses, level of study which the respondents were enrolled in at university, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Table 3. The association between various factors and psychological-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-9.321 (-13.006 to -5.637)	< 0.001*	-2.200 (-4.812 to 0.412)	0.098
-Mean hours of online classes attended per week	0.202 (-0.087 to 0.491)	0.170	0.150 (-0.040 to 0.340)	0.121
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-5.814 (-9.776 to -1.852)	0.004*	0.362 (-2.270 to 2.994)	0.787
-Was your place of living highly prevalent for COVID-19 positive cases?				
No	Reference		Reference	
Yes	-5.438 (-9.550 to -1.326)	0.010*	-3.112 (-5.658 to -0.566)	0.017*
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	5.212 (1.180 to 9.245)	0.011*	2.433 (-0.105 to 4.971)	0.060
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-1.440 (-1.601 to -1.278)	< 0.001*	-0.645 (-0.898 to -0.393)	< 0.001*
-Mean DASS-21 Anxiety Subscale score	-1.119 (-1.323 to -0.916)	< 0.001*	-0.178 (-0.444 to 0.087)	0.187

-Mean DASS-21 Stress Subscale score	-1.204 (-1.369 to -1.038)	< 0.001*	-0.123 (-0.404 to 0.157)	0.387
Social support:				
-Mean family support score	9.082 (7.854 to 10.311)	< 0.001*	2.978 (1.633 to 4.322)	< 0.001*
-Mean friend support score	8.500 (7.200 to 9.800)	< 0.001*	2.369 (1.026 to 3.712)	0.001*
-Mean significant other support score	6.744 (5.589 to 7.899)	< 0.001*	2.133 (1.004 to 3.263)	< 0.001*

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(20,295) = 30.897$, $p < 0.001$ with $R^2 = 0.677$, adjusted for age, gender, marital status, living expenses, level of study which the respondents were enrolled in at university, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Table 4. The association between various factors and social relationship-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-7.319 (-11.306 to -3.332)	< 0.001*	-0.727 (-4.077 to 2.622)	0.669
-Mean hours of online classes attended per week	0.235 (-0.072 to 0.542)	0.133	0.190 (-0.053 to 0.433)	0.125
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-6.224 (-10.435 to -2.012)	0.004*	-2.487 (-5.862 to 0.888)	0.148
-Was your place of living highly prevalent for COVID-19 positive cases?				
No	Reference		Reference	
Yes	-2.973 (-7.379 to 1.433)	0.185	-1.576 (-4.841 to 1.688)	0.343
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	6.353 (2.080 to 10.627)	0.004*	4.013 (0.758 to 7.267)	0.016*
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-1.068 (-1.279 to -0.858)	< 0.001*	-0.113 (-0.437 to 0.211)	0.491
-Mean DASS-21 Anxiety Subscale score	-0.861 (-1.096 to -0.627)	< 0.001*	-0.198 (-0.539 to 0.142)	0.252

-Mean DASS-21 Stress Subscale score	-0.913 (-1.115 to -0.711)	< 0.001*	-0.060 (-0.420 to 0.300)	0.742
Social support:				
-Mean family support score	8.547 (7.149 to 9.945)	< 0.001*	2.091 (0.367 to 3.815)	0.018*
-Mean friend support score	9.576 (8.239 to 10.913)	< 0.001*	5.304 (3.582 to 7.026)	< 0.001*
-Mean significant other support score	6.895 (5.647 to 8.142)	< 0.001*	2.164 (0.716 to 3.612)	0.004*

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(20,295) = 16.624$, $p < 0.001$ with $R^2 = 0.530$, adjusted for age, gender, marital status, living expenses, level of study which the respondents were enrolled in at university, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Table 5. The association between various factors and environmental-related QoL

Variables	Simple linear regression		Multiple linear regression model[a]	
	B (95% CI)	p-value	B (95% CI)	p-value
COVID-19 related stressors and coping:				
-Frustration due to loss of daily routine:				
No	Reference		Reference	
Yes	-4.879 (-7.886 to -1.873)	0.002*	-1.505 (-4.197 to 1.187)	0.272
-Mean hours of online classes attended per week	0.281 (0.052 to 0.510)	0.016*	0.182 (-0.013 to 0.377)	0.068
-Frustration due to study disruption:				
No	Reference		Reference	
Yes	-4.390 (-7.556 to -1.223)	0.007*	-2.537 (-5.249 to 0.175)	0.067
-Was your place of living highly prevalent for COVID-19 positive cases?		\		
No	Reference		Reference	
Yes	-1.263 (-4.577 to 2.051)	0.454	0.705 (-1.919 to 3.328)	0.597
-Religion helped you to cope with stress during COVID-19?				
No	Reference		Reference	
Yes	4.361 (1.146 to 7.576)	0.008*	3.930 (1.315 to 6.545)	0.003*
Psychological characteristics:				
-Mean DASS-21 Depression Subscale score	-0.690 (-0.855 to -0.526)	< 0.001*	-0.097 (-0.357 to 0.163)	0.464
-Mean DASS-21 Anxiety Subscale score	-0.544 (-0.724 to -0.363)	< 0.001*	-0.264 (-0.537 to 0.010)	0.059

-Mean DASS-21 Stress Subscale score	-0.588 (-0.745 to -0.431)	< 0.001*	0.055 (-0.234 to 0.344)	0.710
Social support:				
-Mean family support score	5.658 (4.556 to 6.760)	< 0.001*	1.794 (0.409 to 3.179)	0.011*
-Mean friend support score	6.328 (5.255 to 7.400)	< 0.001*	3.100 (1.716 to 4.483)	< 0.001*
-Mean significant other support score	4.756 (3.792 to 5.719)	< 0.001*	2.369 (1.205 to 3.532)	< 0.001*

* = statistical significance at $p < 0.05$; a = multiple linear regression model reported that $F(20,295) = 12.631$, $p < 0.001$ with $R^2 = 0.425$, adjusted for age, gender, marital status, living expenses, level of study which the respondents were enrolled in at university, course enrolled in university, living arrangement, history of pre-existing medical, depressive and anxiety disorders

Supplementary file 1

The questions for assessment of and coding of the demographic, personal, clinical, and psychological characteristics of the participants

Demographic characteristics

The age of participants was recorded as a continuous variable. The gender of participants was categorized into males and females. The marital status was coded into two groups, such as "married" and "single, divorce, or widowed". Monthly living expenses was categorized into two groups, such as "≤ Ringgit Malaysia 3000" and "> Ringgit Malaysia 3000".

Personal characteristics

The response to the level of study which the respondents were enrolled in at university was recorded as "undergraduate course" and "postgraduate course". The responses to the types of course enrolled was reported in two groups: "medical science-based course" (Bachelor of Science, Master of Science and Doctorate degree) and "medicine-based course" (Bachelor of Medicine and Surgery, Master of Medicine and subspeciality training). The responses to living arrangement was coded as "living alone or living with friends" and "living with family".

Clinical factors

History of pre-existing medical illnesses was evaluated through the question, "Do you have history of any medical illnesses?" The responses were coded as "No" and "Yes". History of pre-existing depressive and anxiety disorders was evaluated through the question, "Do you have history of any depressive or anxiety disorders?" The responses were coded as "No" and "Yes".

COVID-19 related stressors and coping

Hours of online classes attended per week was reported as a continuous variable. Perceived prevalence of COVID-19 cases at the area of living was investigated through the question, "Was your place of living located in an area with high prevalence of COVID-19 positive cases?" The responses were coded as "No" and "Yes". Frustration due to loss of daily routine was reported through the question, "Did you feel frustrated during the movement control order because of loss of daily routine which you usually performed prior to the emergence of the COVID-19 pandemic?" The responses were coded as 'No' and 'Yes'. Frustration due to disruption of study

was assessed through the question, “Did you feel frustrated during the movement control order because your study or academic activities were disrupted?” The responses were coded as ‘No’ and ‘Yes’. The use of religious coping in managing stress during the COVID-19 pandemic was recorded based on the question, ‘Did religion help you to cope with stress during the COVID-19 pandemic?’ The responses were coded as ‘No’ and ‘Yes’.

Supplementary file 2

Socio-demographic, COVID-19 related and clinical characteristics questionnaire (English version)

Date:

Instruction: Please answer all the questions below.

Part A (Socio-demographic data):

(1) Age: _____ years

(2) Gender:

- ◯ Male
- ◯ Female

(3) Marital status:

- ◯ Married
- ◯ Single/divorcee/widow/widower

(4) Average monthly expenses:

- ◯ < RM 1000
- ◯ RM 1000 – RM 3000
- ◯ > RM 3000

Part B (Personal characteristics):

(1) The level of study you enrolled in the university:

- ◯ Undergraduate course
- ◯ Postgraduate course

(2) Course enrolled in the university:

- Medical science related (BSc/MSc/PhD)
- Medicine related (MBBS/MMed/subspeciality)

(3) Who did you live with when the movement control order was enforced in Malaysia?

- I live alone/I live with friends or coursemates
- I live with my family

Part C (Clinical characteristics):

(1) Any history of pre-existing medical/surgical illnesses diagnosed by doctors?

- Yes
- No

(2) Any history of pre-existing depressive and anxiety disorders diagnosed by doctors?

- Yes
- No

Part D (COVID-19 related stressors and religious coping):

(1) Did you feel frustrated because of loss of daily routine during the movement control order?

- Yes
- No

(a) If yes, what were the daily routines which you were unable to do during the movement control order which cause you the frustration?

(2) On average, how many hours did you attend online classes in a week during the movement control order?

_____ hours

(3) Did you feel stressful because your study was disrupted during the movement control order?

- Yes
- No

(a) If yes, what made you stress up when your study was disrupted during movement control order?

(4) Were COVID-19-positive cases highly prevalent in your area of living during the movement control order?

- Yes
- No

(5) Did religion help you to cope with stress and frustration during the movement control order and COVID-19?

- Yes
- No

Thank you for answering all the questions. We appreciate your cooperation.

Soal selidik sosiodemografi, ciri-ciri berhubungkait dengan COVID-19 dan ciri-ciri klinikal (Malay version)

Tarikh:

Arahan: Sila jawab semua soalan dibawah.

Bahagian A (Data sosiodemografi):

(1) Umur:_____ tahun

(2) Jantina:

- ◯ Lelaki
- ◯ Perempuan

(3) Status perkahwinan:

- ◯ Berkahwin
- ◯ Belum kahwin/duda/janda

(4) Purata perbelanjaan bulanan:

- ◯ < RM 1000
- ◯ RM 1000 – RM 3000
- ◯ > RM 3000

Bahagian B (Ciri-ciri peribadi):

(1) Tahap kursus yang didaftar di universiti:

- ◯ Kursus sarjana muda
- ◯ Kursus pascasiswazah

(2) Kursus yang didaftar di universiti:

- ◯ Kursus berkaitan dengan sains perubatan (BSc/MSc/PhD)
- ◯ Kursus berkaitan dengan perubatan (MBBS/MMed/subspeciality)

(3) Anda tinggal dengan siapa semasa perintah kawalan pergerakan di Malaysia dilaksanakan?

- ◯ Saya tinggal bersendirian/Saya tinggal dengan kawan atau rakan sekursus
- ◯ Saya tinggal bersama dengan keluarga

Bahagian C (Ciri-ciri klinikal):

(1) Adakah anda mempunyai sejarah penyakit medikal/surgikal yang didiagnosis oleh doktor?

- ◯ Ya
- ◯ Tidak

(2) Adakah anda mempunyai sejarah penyakit kemurungan dan keresahan yang didiagnosis oleh doktor?

- ◯ Ya
- ◯ Tidak

Bahagian D (Stres berhubungkait dengan COVID-19 dan menangani stres secara keagamaan):

(1) Adakah anda berasa kecewa kerana kehilangan rutin harian semasa perintah kawalan pergerakan?

- ◯ Ya
- ◯ Tidak

(a) Jika ya, apakah rutin harian yang tidak dapat anda laksanakan semasa perintah kawalan pergerakan sehingga menyebabkan kekecewaan?

(2) Dalam purata, berapa jamkah anda menghadiri kelas atas talian dalam seminggu semasa perintah kawalan pergerakan?

_____ jam

(3) Adakah anda berasa tertekan kerana pembelajaran anda tersekat semasa perintah kawalan pergerakan?

- Ya
- Tidak

(a) Jika ya, apakah yang menyebabkan anda tertekan apabila pembelajaran anda tersekat semasa perintah kawalan pergerakan?

(4) Adakah kes positif COVID-19 tinggi kekerapannya di Kawasan tempat tinggal anda semasa perintah kawalan pergerakan?

- Ya
- Tidak

(5) Adakah keagamaan membantu anda menangani stres dan kekecewaan semasa perintah kawalan pergerakan dan COVID-19?

- Ya

Tidak

Terima kasih kerana menjawab kesemua soalan. Kami menghargai kerjasama anda.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1	
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2	
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4	
Objectives	3	State specific objectives, including any prespecified hypotheses	4	
Methods				
Study design	4	Present key elements of study design early in the paper	5	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-8	
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5	
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8, section 1 of supplementary material	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8, section 1 of supplementary material	
Bias	9	Describe any efforts to address potential sources of bias	5-6	

Study size	10	Explain how the study size was arrived at	5

Continued on next page

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	7
		© *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	9-11, Table 2 to 5
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-11, Table 2 to 5
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A

Continued on next page

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.