

## **Depression, Anxiety, Stress, and Quality of Life Among the University Students in Macao: A Cross-Sectional Study**

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### **Abstract**

In the present study, we aimed to assess the mental well-being and overall quality of life of university students in Macao during the COVID-19 pandemic. A web-based cross-sectional survey using the Depression, Anxiety & Stress Scales (DASS-21) and WHO-Quality of Life (WHOQOL) self-administered online questionnaire was distributed through social media platforms and email invitations to university students from various tertiary institutions in Macao. Based on data from 381 university student (50.7% female) aged 18-25 years old, the present study demonstrated that the mental health ( $p < 0.001$ ) and overall quality of life ( $p < 0.001$ ) of university students decreased significantly during the COVID-19 pandemic. Specifically, female and senior students suffered more psychological pressure and worse quality of life than their male and junior counterparts. This original study showcases that the COVID-19 pandemic severely affected the mental well-being and overall quality of life of university students in Macao. As the present study is the first of its kind, these findings fill a gap for academic research and provide insights for the Macao higher education sector in developing policies to address psychological problems and improve quality of life of university students especially in unprecedented circumstances.

**Keywords:** *COVID-19, Quality of life, Depression, Anxiety & Stress, University students, Macao*

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## 1. Introduction

The SARS-CoV-2 coronavirus has infected over 600 million individuals and caused over 6 million deaths worldwide (Worldometers, 2022). Economic collapse, the imposition of nationwide quarantines or curfews, and stringent health inspections disrupted the fundamental foundations of people's lives. The requirement for social distancing coupled with widespread COVID-19 fallacies and disinformation, as well as modern travel restrictions and quarantine orders significantly increased public anxiety, adversely affecting people's mental wellbeing and quality of life (Huang and Zhao, 2020).

Higher education institutions shut down their campuses and rapidly shifted to remote learning. In the middle of the semester, students were required to withdraw from their part time jobs, adapt to a new online learning environment, and evacuate on short notice. Students experienced psychological anguish as a result of these developments, which were both intense and unprecedented (Lee *et al.*, 2021). The virus's high transmissibility and the urgent need to contain it drastically altered the nature of academic interactions, particularly those between students and their instructors. Virtual learning and education as well as virtual research, have gradually displaced the traditional face-to-face experience of university life (Chu and Li, 2022). Furthermore, students living in dormitories were encouraged to avoid all forms of socializing. These trends had serious consequences on students' overall quality of life and well-being, especially for international students who were separated from their familiar social groups and families (Antwi *et al.*, 2022). Though the uncontrolled responses had subsided somewhat by 2022, the virus is still present, mutating into more nasty variations in some nations. Therefore, in many regions around the globe, the need for social distancing continues to define the new norm (Starr *et al.*, 2021).

University students are one group of emerging or young people between the ages of 18 and 25 who have been negatively affected by the pandemic. Students faced fear and uncertainty about their education and future prospects, as well as feelings of social alienation and a lack of support, as a result of the rapid closures of universities (Elmer *et al.*, 2020). Post-secondary students often encounter significant personal, social and academic challenges during their higher education journey, which can contribute to enhanced levels of stress and anxiety (Ribeiro *et al.*, 2018). More broadly, the phase of emerging adulthood is considered a sensitive time during which

individuals may experience the emergence of mental health conditions, including anxiety and depression (Patten, 2017), which can be detrimental to developmental outcomes by engaging in poor health actions, rising substance use and lowering academic achievement (Arnett *et al.*, 2014).

The effect of the pandemic peak on the psychological and mental well-being of the general population remains unclear at this time (Tran *et al.*, 2020). Given the uncertainty and confusion a modern virus's transmission has caused, which seems to have reached a scale never before seen, it is especially important to solve this. According to what is known from the literature, most studies related to COVID-19 have concentrated on understanding the virus's genetic and epidemiological composition, analyzing the clinical features of infected individuals, and examining the challenges faced by global health governance (Wang *et al.*, 2020). In addition, most previous researches have focused on health care workers (Chen *et al.*, 2020) or the general populations (Gao *et al.*, 2020), and their findings may not be applicable to university students.

Few studies have recently compared the mental well-being of students by gender amid the pandemic. For instance, research from France indicated that female students scored much higher on distress, anxiety and depression evaluations than male students (Essadek and Rabeyron, 2020). When investigating anxiety of Chinese college students amid the pandemic, there was no massive gender difference (Cao *et al.*, 2020). On the other hand, mental well-being of Italian students was investigated before, during, and after the pandemic lockdown, and it was discovered that both male and female students suffered severe distress symptoms during the lockdown (Meda *et al.*, 2021). However, previous research did not specifically examine students in Macao. The mental well-being of university students in this region during the pandemic remains an underexplored area.

To address this gap, we conducted the present study to investigate the direct impact of the pandemic on the overall quality of life and psychological stress experienced by university students. Our study examined whether the pandemic induced psychological stress among students in Macao, explored potential gender differences in this impact, and investigated whether senior students (year three and four) faced greater stress than junior students (year one and two). Given the potential consequences on psychological health, employment and education within the university community, it is crucial to implement tailored psychological interventions and measurements during

this crisis. The findings can potentially guide Macao's education sector in better supporting university students, helping them adapt to the challenging environment, addressing psychological issues and enhancing their overall quality of life.

We therefore, hypothesized that the COVID-19 pandemic would have a negative impact on female university students and that senior students would suffer more psychological distress. Specifically, we aimed to investigate the depression, anxiety and stress in relation to the perceived quality of life among university students in Macao pre- and post-pandemic.

## **2. Methodology**

### ***2.1. Participants***

University students in Macao aged between 18 and 25 years old who met the following criteria were invited to participate in the present study: 1) Current students enrolled in any higher education institutions in Macao; 2) Age between 18 and 25 years old; 3) There was no restriction on gender; 4) Have access to the online questionnaire; 5) Can read and understand the questionnaire; 6) Consent to participate in the anonymous survey. We set a confidence level of 95 per cent, a response distribution of 50 per cent, and a margin of error of 5 per cent, to generate the most conservative assumption of sample error. The final sample size of no less than 381 university students from various tertiary institutions in Macao participated in the online survey, which took about 20 minutes to complete.

### ***2.2. Development of the Survey***

An online questionnaire was used to conduct the study with a cross-sectional design. The original survey questions of the Depression, Anxiety & Stress Scales (DASS-21) (Lovibond and Lovibond, 1995), and the WHO-Quality of Life (WHOQOL) (World Health Organization, 2022) in the English version were translated to traditional Chinese to fit the context in Macao. These two scales are reliable, simple and applicable, to a variety of perspectives on well-being and health in different regions and populations, including Macao. The questionnaire was piloted by the authors and several colleagues from the department, with the final version being in both English and traditional Chinese prior to dissemination.

The self-administered questionnaire consisted of three parts: demographic data of the respondents, DASS-21 and the WHOQOL. In part one, we collected relevant university students' demographics to understand how these significant indicators varied in the experiences of psychological discomfort among the students. Both open- and closed-ended questions were adopted, including gender (1 = male; 2 = female), age (the students were inquired about their year of birth to determine their age), education level (1 = year 1; 2 = year 2; 3 = year 3; 4 = year 4 or above), and country of origin (1 = Macao; 2 = Hong Kong; 3 = Mainland China; 4 = other).

In part two, we used the DASS-21 survey consisting of three dimensions to measure the university students' emotional states before and during the pandemic. Each dimension consists of 7 items that are categorized into subscales based on related content. There were 21 items in total, adopting a 4-point Likert scale (0 = did not apply to me at all; 1 = applied to me to some degree, or some of the time; 2 = applied to me to a considerable degree or a good part of time; 3 = applied to me very much or most of the time). The three negative feeling scores were determined by adding the items together. The scores for depression, anxiety, and stress were: 'normal' 0 – 9, 0 – 7, 0 – 14; 'mild' 10 – 13, 8 – 9, 15 – 18; 'moderate' 14 – 20, 10 – 14, 19 – 25; 'severe' 21 – 27, 15 – 19, 26 – 33; 'extremely severe' 28+, 20+, 34+, respectively (Lovibond and Lovibond, 1995). The scoring system indicated that more passive emotional states were reflected by higher scores.

In part three, we used the WHOQOL assessment, consisting of four domains to evaluate the university students' overall quality of life prior to and amid the pandemic. Each domain is composed of multiple items including environment (8 items), physical health (7 items), psychological health (6 items), and social relationships (3 items). In addition, there were 2 items related to general health (1 item) and quality of life (1 item). There were 26 items in total, adopting a 5-point Likert scale (World Health Organization, 2022). For each domain of quality of life, we added the scores together and converted them into a final score. The higher the student's total score, the better their perceived quality of life.

### **2.3. Survey Administration**

We distributed electronic consent options and research information to the respondents as online questionnaire link on social media platforms such as WeChat, Facebook, and email invitations. In order to connect with a varied

international student community, we also joined various international student groups on WhatsApp and LINE. University students were also encouraged to share the link with their peers in Macao who met the inclusion criteria through their online social media platforms. Respondents had the right to skip any question or withdraw from the research at any moment without facing any negative repercussions.

**2.4. Data Collection and Analysis**

All data collected were kept confidential, and the anonymity of the respondents was guaranteed. Only members of the research team had access to the data. Descriptive statistical methods were adopted to sum up the demographic variables, including the DASS-21 and the WHOQOL. IBM SPSS Statistics Version 24 software and Microsoft Excel were utilized for all the statistical analysis. Wilcoxon Signed Ranks Test was utilized to compare respondents’ mental states and overall quality of life prior to and amid the pandemic. Independent Sample t-test was also utilized to compare the different demographic groups to explore the impact of different characteristics (i.e., gender, education level) on the quality of life and level of depression, anxiety and stress.

**3. Results**

A total of 381 participants with an average age of 22 years from different universities or higher education institutions in Macao responded to this survey. All consented to participate and completed the questionnaire, resulting in a 100 per cent response rate. 50.7 per cent of the participants were female, and 53.3 per cent of the participants were classified as junior students in their first and second years of study. The majority (79 per cent) of the participants were from Macao, while the remaining participants were from Mainland China and Hong Kong (Table 1).

**Table 1. Demographic Characteristics of All Respondents (n = 381)**

Characteristic		Frequency (n = 381)	Percentage (%)
Gender	Male	188	49.3
	Female	193	50.7
Education level	Junior student (Year 1 & 2)	203	53.3
	Senior student (Year 3 & above)	178	46.7

Characteristic		Frequency (n = 381)	Percentage (%)
Region	Macao	301	79
	Hong Kong	3	0.8
	Mainland China	77	20.2

**3.1. Depression, Anxiety & Stress Scales (DASS-21)**

The Depression, Anxiety & Stress Scales (DASS-21) of all respondents were significantly different before ( $M = 13.5$ ,  $SD = 15.7$ ) and during COVID-19 pandemic ( $M = 33$ ,  $SD = 20.7$ ),  $p < 0.001$  (Table 2). Both male and female students encountered enhanced levels of psychological stress amid the pandemic with female students experiencing a greater increase compared to male students ( $p < 0.001$ ). The results also demonstrated a significant difference ( $p < 0.001$ ) between the DASS-21 index of junior and senior students amid the pandemic (Table 3). During the pandemic, both junior and senior students faced heightened levels of psychological stress, with senior students experiencing a higher increase than their junior counterparts.

**Table 2. Depression, Anxiety & Stress Scales During the COVID-19 Pandemic of All Respondents (n = 381)**

Depression Indexes	Depression				Anxiety				Stress			
	Before COVID-19 pandemic		During COVID-19 pandemic		Before COVID-19 pandemic		During COVID-19 pandemic		Before COVID-19 pandemic		During COVID-19 pandemic	
	n	%	n	%	n	%	n	%	n	%	n	%
Normal	326	85.5	192	51.4	322	84.5	155	40.7	325	92.4	259	67
Mild	25	6.6	50	13.1	25	6.6	48	12.6	10	2.6	50	13.1
Moderate	19	5	89	23.4	14	3.7	124	32.5	8	2.1	44	12.5
Severe	5	1.3	28	7.3	4	1	29	7.6	8	2.1	19	5
Extremely Severe	6	1.6	22	4.8	16	4.2	25	6.6	3	0.8	9	2.4
Total	381	100	381	100	381	100	381	100	381	100	381	100

*n* = frequency; % = percentage

**Table 3. Depression, Anxiety & Stress Scales (DASS-21) During the COVID-19 Pandemic Among Different Demographic Groups**

Characteristic		Depression Anxiety & Stress Scales (DASS-21)			<i>p</i> -value
		<i>n</i>	Mean	SD	
Gender	Male	188	24.6	17.6	0.001
	Female	193	41.3	20.1	
Education Level	Junior student	203	23.7	17.2	0.001
	Senior student	178	43.6	19.2	

*n* = frequency; *SD* = standard deviation; The final scale score produces a minimum of 0 points and a maximum of 126 points (Jiang et al., 2021)

**3.2. World Health Organization Quality of Life (WHOQOL)**

Findings indicated a significant difference ( $p < 0.001$ ) in the perceived quality of life between male and female students amid the pandemic with female students' level of satisfaction falling by 15.3 per cent, while that of male students decreased by 6.4 per cent. The findings also revealed a significant difference ( $p < 0.001$ ) in the perceived quality of life between senior and junior students during the pandemic with senior students' satisfaction levels decreasing by 14.1 per cent and junior students' by 8.1 per cent (Table 4).

**Table 4. World Health Organization Quality of Life (WHOQOL) During the COVID-19 Pandemic Among Different Demographic Groups**

Characteristic		The World Health Organization Quality of Life (WHOQOL)			<i>p</i> -value
		<i>n</i>	Mean	SD	
Gender	Male	188	84.9	9	0.001
	Female	193	79	12	
Education Level	Junior student	203	87.1	9.7	0.001
	Senior student	178	76	9.4	

*n* = frequency; *SD* = standard deviation; The lowest score of the WHOQOL is 0, the highest score is 130



#### **4. Discussion**

Students generally felt uncertain about their future and a common concern was anxiety about how long the pandemic would last. The pandemic has caused uncertainty in the financial situation of university students (ElTohamy *et al.*, 2022). Some students needed to work part-time jobs to cover tuition fees and living expenses. Unfortunately, the pandemic has created challenges to find and maintain jobs. Although university students could complete online courses in their dormitories or home, financial pressure remained a significant source of stress. Moreover, students were worried about being infected with the virus. The anxiety of not knowing whether they were ill, further exacerbated their fears. If they developed symptoms or tested positive for COVID-19, they feared infecting others around them (including classmates and friends) which could lead to guilt and further anxiety (Hawley *et al.*, 2021). In addition, they were concerned about spreading the virus to high-risk groups, particularly children and the elderly, who are more vulnerable due to weaker immune systems. Many students lived with such individuals and felt a heightened sense of responsibility for their safety. In other areas of safety concern, students felt that others might not always follow COVID-19 prevention guidelines, such as maintaining good personal hygiene, properly wearing masks and practicing social distancing. leading to concern about environmental safety. Also, due to the safety concerns and possible side effects of the COVID-19 vaccine, students might question about health issue as the vaccine might not provide complete protection against the virus (Jaffe *et al.*, 2022).

It is worth noting that women suffered more psychological stress and experienced poorer quality of life than men during the pandemic, which was in line with the findings from 27 European countries (Koch and Park 2022). Also, there were alike results found in a Macao tertiary institute recently (Wang *et al.*, 2021), where there was a greater probability of women experiencing symptoms of depression than men. Female students might be more affected by academic stress than male students. Another study discovered that female students were more prone to experiencing stress and discomfort brought by online learning (Yu *et al.*, 2021). Therefore, students in general need to have stronger self-discipline and time management skills to cope with online teaching during the pandemic (Iong, 2020). Massive media coverage might make women feel depressed and helpless (Wang and Zhao, 2020). Sometimes, media reports exaggerated the severity of

the pandemic, which could exacerbate women's psychological stress. Furthermore, the pandemic might increase women's health concerns, especially if they have underlying health conditions or were in high-risk groups (Hawley *et al.*, 2021). They were more likely to worry about health effects on their quality of life. Also, female university students might be more affected by social pressure than male university students. During the pandemic, university students need to stay away from campus and peers, which could have a negative impact on their social lives. One study reported that female students had a greater tendency to be affected by social isolation and loneliness (Erden *et al.*, 2022). Women also feared about not having adequate social support and were more prone to seeking support from social networks. However, maintaining these networks could be more difficult due to social distancing measures, this could result in emotions of isolation and loneliness, which could have negative effects on overall quality of life and mental well-being.

Although both junior and senior university students experienced psychological stress during the pandemic, senior students suffered more psychological stress and experienced poorer quality of life than junior students, which was similar to a university study in the United States (Varadarajan *et al.*, 2021). Senior students faced the pressure of graduation and entering the workforce. Concerns about employment prospects, uncertainty regarding future career development and job availability added to their anxiety and restlessness (Jenei *et al.*, 2020). Senior students also have higher academic pressure, as they usually have to complete a lot of graduation papers, coursework and exams. However, due to the impact of the pandemic, they may face greater academic pressure and difficulties, such as being unable to communicate with their supervisors face-to-face. Meanwhile, senior students might have more difficulty adapting to online learning because they might be studying more advanced or specialized courses (Tanveer *et al.*, 2020), which were more difficult to teach and learn online, and they might be more prone to problems such as anxiety and depression. Moreover, with most curricula moving online, senior students might face being cut off from campus social circles. At the same time, they would not be able to participate in graduation trips, graduation ceremonies, celebrations, and other important campus activities as before. They would miss these important events due to the pandemic, which might bring loss and loneliness (Kee, 2021). The lack of social support would directly affect their

quality of life. Furthermore, senior students might face increased financial hardship and housing instability during the pandemic, which might affect their quality of life. Affected by the pandemic, this might result in loss of income or reduced working hours, affecting students' ability to pay for university fees and living expenses (Glantsman *et al.*, 2022). Those living off-campus struggled with rent or risked eviction. Some university students who pursue graduate programs were worried about new challenges like work, housing and new courses. While junior university students might experience some similar stress, senior university students were more affected by their particular circumstances.

Certain limitations to this study must be addressed. First, our study utilized a cross-sectional approach, and this type of self-reported data collection could only provide a snapshot of the information at a specific point of time. It is not possible to make a long-term comparative analysis of the mental well-being of university students in Macao at different time points amid the COVID-19 pandemic, and it is unable to offer information about the changes in the mental well-being and overall quality of life of university students across the Macao region over the long term. Therefore, we suggest that future studies may choose the longitudinal study design to provide stronger evidence for causality and assessment, and a deeper understanding of students' mental well-being.

Due to the restrictions caused by the COVID-19 pandemic, our research used online social media platforms to collect data and relied on convenience sampling, which may not accurately represent the entire population of university students in Macao. We suggest that future studies should combine online and offline data collection methods to avoid self-selection bias in online surveys and generalization of research results. This will expand our understanding of how university students accommodate to the changing circumstances of the pandemic and explore more effective preventive behavior for mental health issues.

## **5. Conclusion**

The present study collected information on the COVID-19 pandemic among university students across the Macao region, focusing on how the pandemic affected their mental well-being and overall quality of life. Specifically, the results showed that compared with before and during the pandemic, the mental well-being and overall quality of life of university students in Macao

decreased significantly. Female university students were more likely than their male counterparts to experience negative impacts of the COVID-19 pandemic on their mental well-being and overall quality of life. Similarly, the mental well-being and overall quality of life experienced by senior students declined more dramatically compared to the junior students.

Prior research in this field did not specifically address university students in Macao. Therefore, this study has made a valuable contribution by filling this gap in academic research. Findings from the present study will be useful to the education sector to better guide university students to adapt to reduce psychological problems and to improve their quality of life. The present study also indicates the need for awareness and careful monitoring of the mental well-being of university students. Universities should enhance their support for students during and after the pandemic. Additionally, they should foster student engagement with society and improve communication between students and university staff. Promoting self-care and encouraging help-seeking behaviors is crucial. Furthermore, providing training for coping with psychological stress can assist students in managing depression, anxiety, and stress during these challenging times.

To mitigate the impact of mental health issues and to achieve a better quality of life, universities should offer psychological services tailored to these circumstances, thereby providing students with greater access to mental health resources. However, it is important to note that this study lacked a control group, preventing direct comparison with non-pandemic conditions. Future research should include such a group to deepen our understanding of pandemic-related changes and develop more effective preventive measures for mental health.

### **Conflict of Interest**

The authors declare that they have no conflicts of interest.

### **Reference List**

- Antwi, C.O., Belle, M.A., Ntim, S.Y., Wu, Y., Affum-Osei, E., Aboagye, M.O. and Ren, J. (2022), "COVID-19 Pandemic and International Students' Mental Health in China: Age, Gender, Chronic Health Condition and Having Infected Relative as Risk Factors", *International Journal of Environmental Research and Public Health*, Vol. 19, No. 13,

- p. 7916. <https://doi.org/10.3390/ijerph19137916>.
- Arnett, J.J., Žukauskienė, R. and Sugimura, K. (2014), “The New Life Stage of Emerging Adulthood at Ages 18–29 Years: Implications for Mental Health”, *The Lancet Psychiatry*, Vol. 1, No. 7, pp. 569-576. [https://doi.org/10.1016/S2215-0366\(14\)00080-7](https://doi.org/10.1016/S2215-0366(14)00080-7).
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J. and Zheng, J. (2020), “The Psychological Impact of the COVID-19 Epidemic on College Students in China”, *Psychiatry Research*, Vol. 1, No. 287, p. 112934. <https://doi.org/10.1016/j.psychres.2020.112934>.
- Chen, Q., Liang, M., Li, Y., Guo, J., Fei, D., Wang, L., He, L., Sheng, C., Cai, Y. and Li, X. (2020), “Mental Health Care for Medical Staff in China During The COVID-19 Outbreak”, *The Lancet Psychiatry*, Vol. 7, No. 4, pp. e15-e16. [https://doi.org/10.1016/S2215-0366\(20\)30078-X](https://doi.org/10.1016/S2215-0366(20)30078-X).
- Chu, Y.H. and Li, Y.C. (2022), “The Impact of Online Learning on Physical and Mental Health in University Students During The COVID-19 Pandemic”, *International Journal of Environmental Research and Public Health*, Vol. 19, No. 5, p. 2966. <https://doi.org/10.3390/ijerph19052966>.
- Elmer, T., Mephram, K. and Stadtfeld, C. (2020), “Students Under Lockdown: Comparisons of Students’ Social Networks and Mental Health Before and During The COVID-19 Crisis in Switzerland”, *PLOS One*, Vol. 15, No. 7, p. e0236337. <https://doi.org/10.1371/journal.pone.0236337>.
- ElTohamy, A., Hyun, S., Macaranas, A.R., Chen, J.A., Stevens, C. and Liu, C.H. (2022), “Testing Positive, Losing a Loved One, and Financial Hardship: Real-World Impacts of COVID-19 on US College Student Distress”, *Journal of Affective Disorders*, Vol. 314, pp. 357-364. <https://doi.org/10.1016/j.jad.2022.07.022>.
- Erden, G., Özdoğru, A.A., Çoksan, S., Ögel-Balaban, H., Azak, Y., Altınoğlu-Dikmeer, İ., Ergül-Topçu, A., Yasak, Y., Kırıl-Uçar, G., Oktay, S., Karaca-Dinç, P., Merdan-Yıldız, E.D., Eltan, S., Kumpasoğlu, G.B. and Baytemir, G. (2022), “Social Contact, Academic Satisfaction, COVID-19 Knowledge, and Subjective Well-Being Among Students at Turkish Universities: A Nine-University Sample”, *Applied Research in Quality of Life*, Vol. 17, No. 4, pp. 2017-2039.
- Essadek, A. and Rabeyron, T. (2020), “Mental Health of French Students During the COVID-19 Pandemic”, *Journal of Affective Disorders*, Vol. 277, pp. 392-393. <https://doi.org/10.1016/j.jad.2020.08.042>.

- Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., Wang, Y., Fu, H. and Dai, J. (2020), "Mental Health Problems and Social Media Exposure During COVID-19 Outbreak", *PLOS One*, Vol. 15, No. 4, pp. 1-10. <https://doi.org/10.1371/journal.pone.0231924>.
- Glantsman, O., McGarity-Palmer, R., Swanson, H.L., Carroll, J.T., Zinter, K.E., Lancaster, K.M. and Berardi, L. (2022), "Risk of Food and Housing Insecurity Among College Students During the COVID-19 Pandemic", *Journal of Community Psychology*, Vol. 50, No. 6, pp. 2726-2745. <https://doi.org/10.1002/jcop.22853>.
- Hawley, S.R., Thrivikraman, J.K., Noveck, N., Romain, T.S., Ludy, M.J., Barnhart, L., Chee, W.S. S., Cho, M.J., Chong, M.H.Z., Du, C., Fenton, J.I., Hsiao, P.Y., Hsiao, R., Keaver, L., Lee, H.S., Shen, W., Lai, C.C., Tseng, K.W., Tseng, W.C. and Tucker, R.M. (2021), "Concerns of College Students During the COVID-19 Pandemic: Thematic Perspectives from The United States, Asia, and Europe", *Journal of Applied Learning and Teaching*, Vol. 4, No 1, pp. 11-20. <https://doi.org/10.37074/jalt.2021.4.1.10>.
- Huang, Y. and Zhao, N. (2021), "Mental Health Burden for The Public Affected by the COVID-19 Outbreak in China: Who Will Be the High-Risk Group?", *Psychology, Health & Medicine*, Vol. 26, No. 1, pp. 23-34. <https://doi.org/10.1080/13548506.2020.1754438>.
- Long, L.T. (2020), "Reflections on Online Teaching Under The COVID-19 Pandemic-Taking the International Chinese Language Program at Macao Polytechnic Institute as An Example", *Intercultural Communication Studies*, Vol. 29, No. 2, p. 6.
- Jaffe, A.E., Graupensperger, S., Blayney, J.A., Duckworth, J.C. and Stappenbeck, C.A. (2022), "The Role of Perceived Social Norms in College Student Vaccine Hesitancy: Implications For COVID-19 Prevention Strategies", *Vaccine*, Vol. 40, No. 12, pp. 1888-1895. <https://doi.org/10.1016/j.vaccine.2022.01.038>.
- Jenei, K., Cassidy-Matthews, C., Virk, P., Lulie, B. and Closson, K. 2020, "Challenges and Opportunities for Graduate Students in Public Health During The COVID-19 Pandemic", *Canadian Journal of Public Health*, Vol. 111, pp. 408-409. <https://doi.org/10.17269/s41997-020-00349-8>.
- Jiang, L.C., Yan, Y.J., Jin, Z.S., Hu, M.L., Wang, L., Song, Y., Li, N.N., Su, J., Wu, D.X. and Xiao, T. (2020), "The Depression Anxiety Stress Scale-21 in Chinese Hospital Workers: Reliability, Latent Structure, and

- Measurement Invariance Across Genders”, *Frontiers in Psychology*, Vol. 11, p. 247. <https://doi.org/10.3389/fpsyg.2020.00247>.
- Kee, C.E. (2021), “The Impact of COVID-19: Graduate Students’ Emotional and Psychological Experiences”, *Journal of Human Behavior in the Social Environment*, Vol. 31, No. 1-4, pp. 476-488. <https://doi.org/10.1080/10911359.2020.1855285>.
- Koch, M. and Park, S. (2022), “Do Government Responses Impact the Relationship Between Age, Gender and Psychological Distress During the COVID-19 Pandemic? A Comparison Across 27 European Countries”, *Social Science & Medicine*, Vol. 292, p. 114583. <https://doi.org/10.1016/j.socscimed.2021.114583>.
- Lee, J., Jeong, H.J. and Kim, S. (2021), “Stress, Anxiety, and Depression Among Undergraduate Students During The COVID-19 Pandemic and Their Use of Mental Health Services”, *Innovative Higher Education*, Vol. 46, No. 5, pp. 519-538. <https://doi.org/10.1007/s10755-021-09552-y>.
- Lovibond, S.H. and Lovibond, P.F. (1995), *Manual for The Depression Anxiety Stress Scales*, 2nd Ed., Sydney: Psychology Foundation.
- Meda, N., Pardini, S., Slongo, I., Bodini, L., Zordan, M.A., Rigobello, P., Visioli, F. and Novara, C. (2021), “Students’ Mental Health Problems Before, During, and After COVID-19 Lockdown in Italy”, *Journal of Psychiatric Research*, Vol. 134, pp. 69-77. <https://doi.org/10.1016/j.jpsychires.2020.12.045>.
- Patten, S.B. (2017), *Age of Onset of Mental Disorders*, Los Angeles, CA: SAGE Publications Sage CA.
- Ribeiro, Í.J., Pereira, R., Freire, I.V., de Oliveira, B.G., Casotti, C.A. and Boery, E.N. (2018), “Stress and Quality of Life Among University Students: A Systematic Literature Review”, *Health Professions Education*, Vol. 4, No. 2, pp. 70-77. <https://doi.org/10.1016/j.hpe.2017.03.002>.
- Starr, T.N., Greaney, A.J., Addetia, A., Hannon, W.W., Choudhary, M.C., Dingens, A.S., Li J.Z. and Bloom, J.D. (2021), “Prospective Mapping of Viral Mutations That Escape Antibodies Used to Treat COVID-19”, *Science*, Vol. 371, No. 6531, pp. 850-854. <https://www.science.org/doi/10.1126/science.abf9302>.
- Tanveer, M., Bhaumik, A., Hassan, S. and Haq, I.U. (2020), “COVID-19 Pandemic, Outbreak Educational Sector and Students Online Learning in Saudi Arabia”, *Journal of Entrepreneurship Education*, Vol. 23, No. 3, pp. 1-14.



- Tran, B.X., Ha, G.H., Nguyen, L.H., Vu, G.T., Hoang, M.T., Le, H.T., Latkin, C.A., Ho, C.S. and Ho, R.C. (2020), “Studies of Novel Coronavirus Disease 19 (COVID-19) Pandemic: A Global Analysis of Literature”, *International Journal of Environmental Research and Public Health*, Vol. 17, No. 11, p. 4095. <https://doi.org/10.3390/ijerph17114095>.
- Varadarajan, J., Brown, A.M. and Chalkley, R. (2021), “Biomedical Graduate Student Experiences During The COVID-19 University Closure”, *PLOS One*, Vol. 16, No. 9, p. e0256687. <https://doi.org/10.1371/journal.pone.0256687>.
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C.S. and Ho, R.C. (2020), “Immediate Psychological Responses and Associated Factors During the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic Among the General Population in China”, *International Journal of Environmental Research and Public Health*, Vol. 17, No. 5, p. 1729. <https://doi.org/10.3390/ijerph17051729>.
- Wang, C. and Zhao, H. (2020), “The Impact of COVID-19 on Anxiety in Chinese University Students”, *Frontiers in Psychology*, Vol. 11, p. 1168. <https://doi.org/10.3389/fpsyg.2020.01168>.
- Wang, X., Liu, M., Tee, S. and Dai, H. (2021), “Analysis of Adversity Quotient of Nursing Students in Macao: A Cross-Section and Correlation Study”, *International Journal of Nursing Sciences*, Vol. 8, No. 2, pp. 204-209. <https://doi.org/10.1016/j.ijnss.2021.02.003>.
- World Health Organization. (2022, September 10), *WHOQOL-BREF: Introduction, Administration, Scoring and Generic Version of The Assessment: Field Trial Version, December 1996* (No. WHOQOL-BREF). <<https://apps.who.int/iris/bitstream/handle/10665/63529/WHOQOLBREF.pdf?sequence=1>>.
- Worldometers. (2022, September 16), *COVID Live Update: 616,155,714 Cases And 6,525,967 Deaths from The Coronavirus*. <<https://www.worldometers.info/coronavirus/>>.
- Yu, L., Huang, L., Tang, H.R., Li, N., Rao, T.T., Hu, D., Wen, Y.F. and Shi, L.X. (2021), “Analysis of Factors Influencing the Network Teaching Effect of College Students in a Medical School During The COVID-19 Epidemic”, *BMC Medical Education*, Vol. 21, No. 1, pp. 1-8. <https://doi.org/10.1186/s12909-021-02825-2>.