

**STRUCTURAL RELATIONSHIP OF
ENVIRONMENTAL FACTORS, PSYCHOLOGICAL
HEALTH AND ACADEMIC PERFORMANCE
AMONG MEDICAL STUDENTS TAKING ONLINE
LEARNING DURING THE COVID-19 PANDEMIC
IN UNIVERSITI SAINS MALAYSIA**

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UNIVERSITI SAINS MALAYSIA

2022

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by

OLA K. A. TALEB

Thesis submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science

(MEDICAL STATISTICS)

August 2022

ACKNOWLEDGEMENT

With the Name of Allah, The Intensely Merciful, The Eternally Merciful

First and foremost, alhamdulillah, at the beginning and forever. I am grateful to Allah, glory to him and the exalted for the good health and well-being that were necessary to the entire completion of this dissertation. I wish to place on records my heartfelt and sincere thanks to my main supervisor Dr. Siti Azrin Binti Ab Hamid, for providing me with an opportunity to complete my master thesis. I appreciate her contributions of ideas to make my work productive and stimulating. I am also extremely grateful to my co-supervisors Assoc. Prof. Dr. Sarimah Binti Abdullah for providing me with all the necessary advice and support during this research. I would like to show my appreciation to Dr Kueh Yee Cheng for her guidance and advice to enhance this research study. A special appreciation to all the lecturers of the Biostatistics and Research Methodology Unit for moulding us with their knowledge and compassion over the past two years. I would like to thank the Deputy Dean of the School of Medical Science Assoc. Prof. Dr. Kamarul Aryffin Bin Baharuddin for helping me to verify the data. Lastly, all brightness in my life is because of my parents. Words cannot express how thankful I am to my parents for their constant support, love, encouragement, and prayers. Last but not least, my deepest thanks go to my beloved husband, Dr. Ali who supported and guided me in all steps of my research, understood the tough situations and gave me the positive energy during my study, his sacrifice and unconditional love supported me throughout to become what I am today.

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LIST OF SYMBOLS

DF	Degree of freedom
H _A	Alternate hypothesis
χ^2	Chi-square
z value	Significant level 5%
=	Equal
<	Less than
>	More than
$\geq$	Equal and more than
%	Percentage
λ_i	Standardized factor loading
e_i	Measurement error of the item
Σ	Summation
θ_{ij}	The covariances between the error terms
r	Correlation
°C	Celsius degree

LIST OF ABBREVIATIONS

AIC	Aikake Information Criterion
BIC	Bayesian Information Criterion
BL	Blended Learning
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CGPA	Cumulative Grade Points Average
CR	Composite Reliability
CI	Confidence Interval
COVID-19	Coronavirus disease 2019
DASS	Depression Anxiety Stress Scale
e.g	exempli gratia or for example
GPA	Grade Points Average
GHQ	General Health Questionnaire
IEQ	Indoor Environmental Quality
IHR	International Health Regulations
JEPeM	Jawatankuasa Etika Penyelidikan Manusia
LMS	Learning Management System
LNT	Lighting, Noise, and Temperature
MCO	Movement Control Order
MCQ	Multiple Choice Question
MD	Medical Doctor
MI	Modification Indices

ML	Maximum Likelihood estimation
MLR	Maximum Likelihood estimation with Robust standard errors
MOOC	Massive Online Open Courses
MTF	Multiple true/false
NC	Normed chi-square
NHMSII	Second National Health and Morbidity Surveys
NHMS III	Third National Health and Morbidity Surveys
OSCE	Objective Structured Clinical Examination
PHQ	Patient Health Questionnaire
QEOC	Questionnaire of Effects from Online Classes
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
SAD	Stress, anxiety, and depression
SBA	Single best answer
SBQ	Scenario-based question
SD	Standard deviation
SEM	Structural Equation Modelling
SEQ	Short essay question
SRMR	Standardized Root Mean Square Residual
SPSS	Statistical Package for Social Sciences
SSSF	Student Satisfaction Survey Form
TLI	TuckerLewis Index
UAE	United Arab Emirates
UK	United Kingdom
US	United States

USM	Universiti Sains Malaysia
WebCT	web-based system
WHO	World Health Organization
WLSMV	Weighted Least Squares

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**PERHUBUNGAN STRUKTURAL ANTARA PERSEKITARAN,
KESIHATAN PSIKOLOGI, TEKNOLOGI DAN PENCAPAIAN AKADEMIK
DALAM KALANGAN PELAJAR PERUBATAN YANG MENGAMBIL
PEMBELAJARAN SECARA ATAS TALIAN SEMASA PANDEMIK COVID-19
DI UNIVERSITI SAINS MALAYSIA**

ABSTRAK

Pengenalan: Wabak COVID-19 dan penguatkuasaan tempoh kuarantin telah menyebabkan universiti di Malaysia menukar kelas secara bersemuka kepada kelas atas talian. Faktor persekitaran baharu ini mungkin mengganggu dan memberi kesan kepada kesihatan psikologi dan prestasi akademik pelajar. **Objektif:** Kajian ini bertujuan untuk menentukan kesahan pengukuran skala faktor persekitaran versi Bahasa Inggeris, menentukan min skor faktor persekitaran dan kesihatan psikologi pelajar dan mengkaji hubungan antara pembolehubah dengan prestasi akademik dalam kalangan pelajar sarjana muda perubatan di Kampus Kesihatan, Universiti Sains Malaysia (USM). **Kaedah:** Kajian keratan rentas telah dijalankan, menggunakan soal selidik yang diisi sendiri dalam talian dalam kalangan pelajar sarjana muda perubatan di Kampus Kesihatan, USM daripada Ogos 2021 sehingga Mei 2022. Peserta dipilih menggunakan kaedah pensampelan mudah. Faktor persekitaran diukur menggunakan skala pencahayaan, bunyi, dan suhu (PBS) dan teknologi, kesihatan psikologi dinilai menggunakan *General Health Questionnaire* versi pendek (*GHQ- 12*), dan Purata Nilai Gred (PNG) untuk prestasi akademik. Statistik deskriptif, analisis faktor pengesahan (CFP) dan pemodelan persamaan struktur (PPS) digunakan dalam analisa

statistik. **Keputusan:** Seramai 218 pelajar mengambil bahagian dalam kajian CFP, dan 207 pelajar mengambil bahagian dalam kajian PPS. Kebanyakan pelajar tinggal di dalam kampus dan menggunakan Wi-Fi universiti. Dalam kesahan model pengukuran, PBS versi Bahasa Inggeris dengan sembilan item menunjukkan kesesuaian yang baik dengan data tanpa item yang dibuang: *Comparative Fit Index (CFI)* = 0.99, *Tucker Lewis Index (TLI)* = 0.98, *Standardized Root Mean Square Residual (SRMR)* = 0.03, *Root Mean Square Error of Approximation (RMSEA)* (90% selang keyakinan (SK)) = 0.03 (0.00, 0.07). *Composite Reliability (CR)* ialah 0.82, 0.81, dan 0.84 dan *Average Variance Extracted (AVE)* ialah 0.61, 0.59 dan 0.63. Skala teknologi versi Bahasa Inggeris dengan enam item juga menunjukkan kesesuaian yang baik dengan data tanpa item yang dibuang: *CFI* = 0.99, *TLI* = 0.97, *SRMR* = 0.02, *RMSEA* (90% SK) = 0.06 (0.00, 0.16). *CR* ialah 0.84, dan *AVE* ialah 0.51. Min skor (sisihan piawaian (SP)) pencahayaan, bunyi, suhu, teknologi, dan kesihatan psikologi masing-masing ialah 4.26 (0.71), 3.52 (0.91), 3.93 (0.80), 3.98 (0.58) dan 4.16 (3.92). Selain itu, model akhir PPS menunjukkan kesesuaian yang baik dengan data: *CFI* = 0.96, *TLI* = 0.95, *SRMR* = 0.05, *RMSEA* (90%CI) = 0.04 (0.02, 0.06) dengan satu hipotesis disokong, iaitu kesihatan psikologi dengan prestasi akademik ($\beta = -0.21$, $p = 0.004$). Tiada hubungan yang signifikan di antara faktor persekitaran dan pencapaian akademik serta faktor persekitaran dengan kesihatan psikologi. **Kesimpulan:** Hasilnya menyediakan bukti psikometrik untuk menggunakan skala soal selidik persekitaran untuk menilai faktor-faktor yang dikaitkan dengan prestasi akademik dalam kalangan pelajar perubatan universiti di Malaysia. Semua item telah dikekalkan dan disahkan sesuai untuk data sampel. Model struktur hipotesis yang diuji dalam kajian ini, menyokong

bukti saintifik tentang hubungan songsang antara kesihatan psikologi dan prestasi akademik. Penemuan ini boleh membantu ahli akademik, penggubal dasar kesihatan dan pendidik kesihatan dalam memahami dan mempromosikan kesihatan psikologi dalam kalangan pelajar universiti serta meningkatkan kejayaan akademik mereka.

Kata kunci: perhubungan struktural, faktor persekitaran, kesihatan psikologi, pencapaian akademik, pembelajaran atas talian, COVID-19

**STRUCTURAL RELATIONSHIP OF ENVIRONMENTAL FACTORS,
PSYCHOLOGICAL HEALTH AND ACADEMIC PERFORMANCE AMONG
MEDICAL STUDENTS TAKING ONLINE LEARNING DURING THE COVID-
19 PANDEMIC IN UNIVERSITI SAINS MALAYSIA**

ABSTRACT

Introduction: The COVID-19 outbreak, and quarantined period have enforced the universities in Malaysia to turn the face-to-face classrooms into online classes. These new environmental factors may be disturbing and have an impact on students' psychological health and academic performance. **Objective:** This study aimed to determine the measurement validity of the English version scales of environment factors, determine the mean scores of environmental factors and psychological health of the students, and examine their structural relationship with academic performance among undergraduate medical students in Health Campus, Universiti Sains Malaysia (USM). **Methods:** A cross-sectional study was conducted using an online self-reported questionnaire among undergraduate medical students in Health Campus, USM from August 2021 to May 2022. Participants were selected using convenience sampling. Environmental factors were measured using lighting, noise, and temperature (LNT) and technology scales, psychological health was assessed using the short version General Health Questionnaire (GHQ- 12) and Grade Point Average (GPA) for academic performance. Descriptive statistics, confirmatory factor analysis (CFA) and structural equation modelling (SEM) were used in the statistical analyses. **Results:** A total of 218 students participated in CFA study and 207 students participated in SEM study. Most of

students stay inside campus and use the university Wi-Fi. In the measurement model validity, the English version of LNT with nine items revealed a good fit to the data with no item deleted: Comparative Fit Index (CFI) = 0.99, Tucker Lewis Index (TLI) = 0.98, Standardized Root Mean Square Residual (SRMR) = 0.03 and Root Mean Square Error of Approximation (RMSEA) (90%CI) = 0.03 (0.00, 0.07). The Composite Reliability (CR) was 0.81, 0.81, and 0.84 and the Average Variance Extracted (AVE) was 0.61, 0.59 and 0.63. The English version of the technology scale with six items also showed a good fit to the data with no item deleted: CFI = 0.99, TLI = 0.97, SRMR = 0.02, Root Mean RMSEA (90%CI) = 0.06 (0.00, 0.16). The CR was 0.84, and AVE was 0.51. The mean (standard deviation (SD)) score of LNT, technology, and psychological health were 4.26 (0.71), 3.52 (0.91), 3.93 (0.80), 3.98 (0.58), and 4.16 (3.92) respectively. In addition, the SEM final model showed a good fit to the data: CFI = 0.96, TLI = 0.95, SRMR = 0.05, RMSEA (90%CI) = 0.04 (0.02, 0.06) with one hypothesis supported, which was psychological health with academic performance ($\beta = -0.21$, $p = 0.004$). There was no significant relationship between environmental factors and academic performance, as well as environmental factors with psychological health. **Conclusion:** The results provide psychometric evidence for applying the environmental questionnaire scales to evaluate the factors that are associated with academic performance participation among university medical students in Malaysia. All items were retained and confirmed to be fit for the sample data. The hypothesised structural model tested in this study, supported scientific evidence of inverse relationships between psychological health and academic performance. The findings could be helpful to academics, health policymakers, and health educators in understanding and

promoting psychological health among university students, as well as improving their academic success.

Keywords: structural relationship, environmental factors, psychological health, academic performance, online learning, COVID-19

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

1.1.1 COVID-19 Cases

The novel coronavirus-2 (SARS-Cov-2) has spread from China to all over the world. On March 11, 2020, the World Health Organization (WHO) declared the coronavirus disease (COVID-19) outbreak as a global pandemic (WHO, 2020). The first COVID-19 case outside China was reported in Thailand on January 13, 2020 (Woodward & Neilson, 2020). The first case was reported in the United States (US) on January 20, 2020. On January 31, 2020, Sweden and Spain reported the first case, while Russia and the United Kingdom reported their first two cases, respectively (Woodward & Neilson, 2020). On 23 January 2020 Singapore reported the first imported case (Lum & Tambyah, 2020). Indonesia declared the first COVID-19 case on March 2, 2020 (Setiawaty et al., 2020).

In Malaysia, the first wave of outbreaks started from January 25 to February 15, 2020, with 22 cases. The first three cases were detected on tracing and screening after communication from the Singapore Ministry of Health that eight close contacts of a confirmed case of Chinese nationality in Singapore had travelled into Johor, Malaysia. By February 15, the number of cases in Malaysia increased to 22 (Hashim et al., 2021).

The second wave of the outbreak started on February 27 until April 29, 2020, with 5,945 cases. New cases began to appear as people who had international travel history to countries such as China, Japan, Italy, and Australia started to manifest symptoms. Clusters of cases began to form from the close contacts of confirmed cases

who attended meetings and events together, which generated several generations of infections (Hashim et al., 2021).

On March 11, 2020, the International Health Regulations (IHR) Malaysia was informed by IHR Brunei that one positive case in Brunei was discovered to have attended a religious gathering in Seri Petaling Mosque, Selangor, Malaysia from February 27 to March 1, 2020. More than 10,000 people from various nations attended this event, with at least half of them coming from Malaysia (Zainal, 2020). The third wave of the outbreak was in early October with the highest number of cases coming from Sabah (8,082), Selangor (3,357), Kuala Lumpur (2,853), and Kedah (1,940) from September 1 to October 19 (Ahamed, 2020). Figure 1.1 showed the total cases of COVID-19 in Malaysia (Worldometer, 2022).

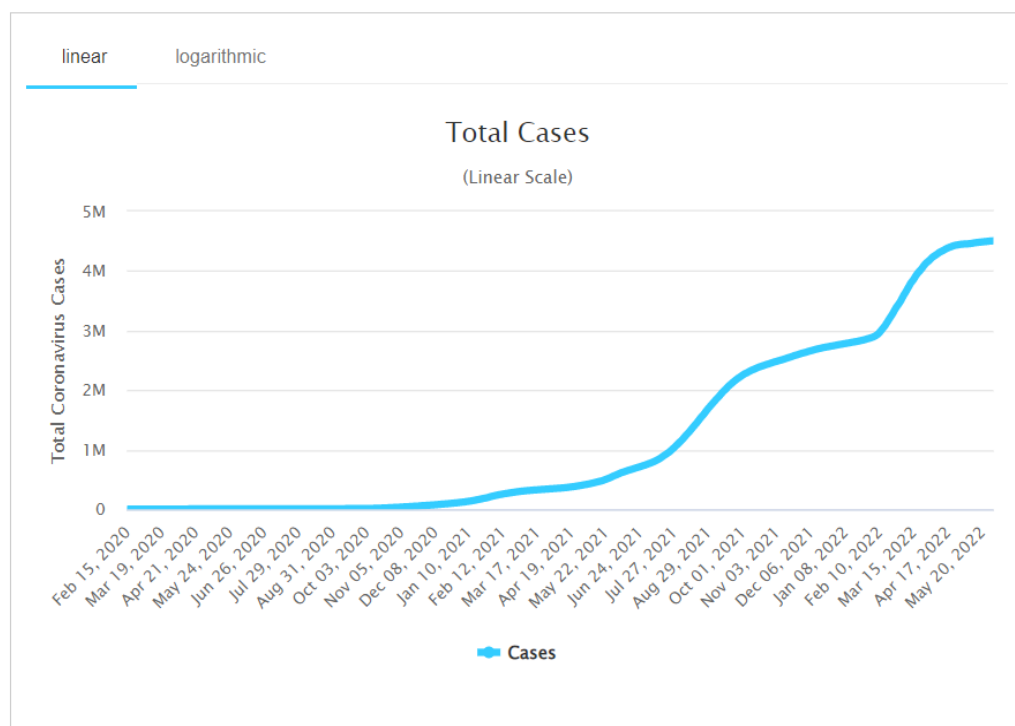
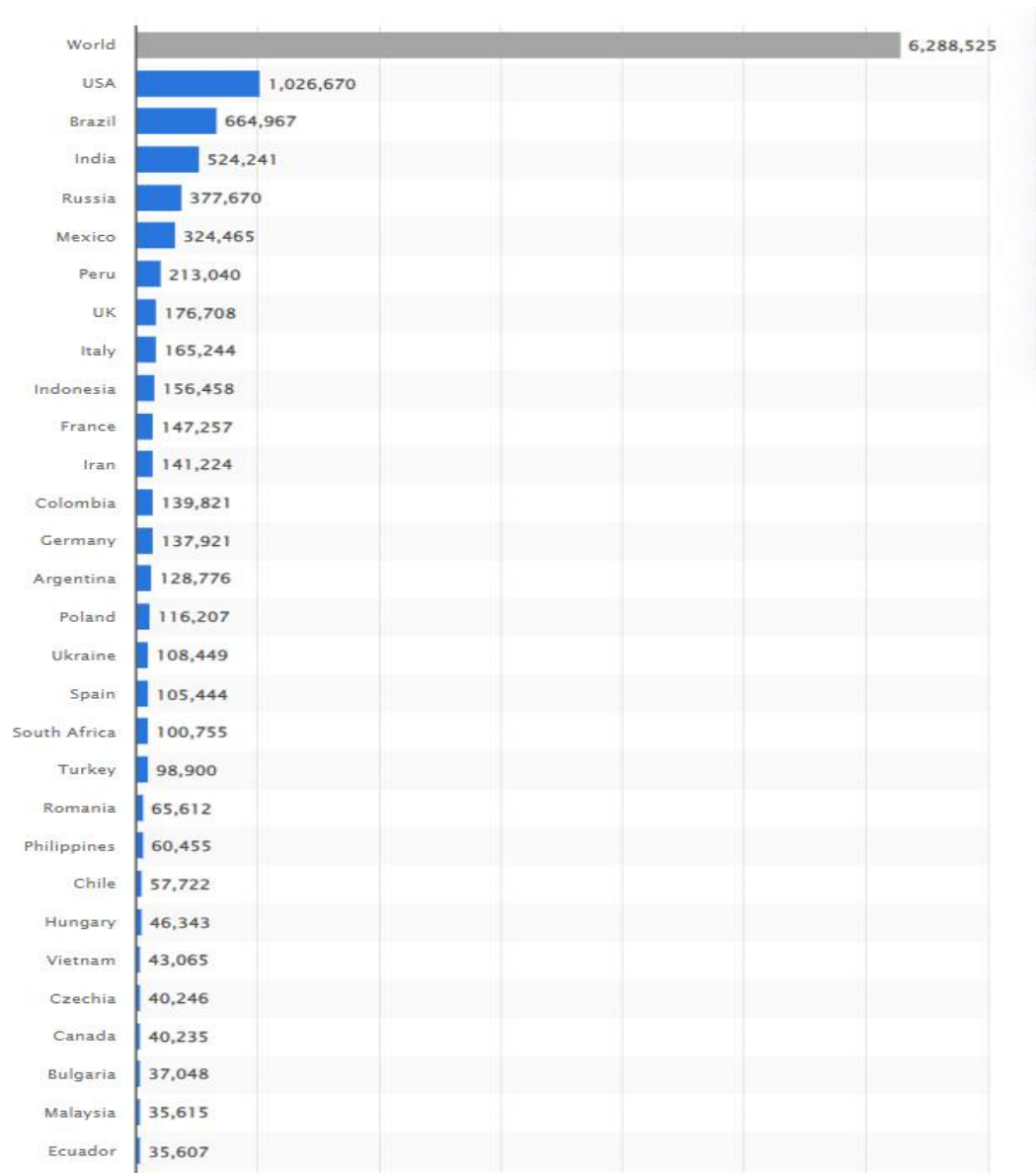


Figure 1.1 Total of COVID-19 cases in Malaysia

1.1.2 Impact of COVID-19

The global disruption by COVID-19, poses a massive challenge to global health and continue to affect people worldwide. COVID-19 can be recovered well after being infected. All cases of COVID-19 during the first wave in Malaysia recovered from the infection (Ministry of Health Malaysia, 2020a). However, with presence of comorbidities and late of receiving treatment might have poor prognosis. China reported its first death on January 11, 2020 (WHO, 2020a). Figures 1.2 showed the number of COVID-19 deaths worldwide as of May 16, 2022, by country (Statista, 2022).



Many countries like the US, United Kingdom (UK), France, China and include Malaysia have locked down and quarantined their population to control the spread of the disease (Seetan et al., 2021). In the UK, the first nationwide ‘lockdown’ was imposed on March 23rd, 2020 (Evans et al., 2021). Libya, since March 2020 has implemented several restrictive procedures including lockdown measures to control virus spread (Msherghi et al., 2021). While in Malaysia, the Movement Control Order (MCO) on March 18, 2020 was implemented to keep the spread and mortality under control.

Restrictive measures had shown an effectiveness. The pandemic could be contained by isolating the infected group of individuals and practicing social distancing, as shown in China (WHO, 2020a). The borders and all academic institutions were closed with economic activities came to a standstill. The implication of the restrictive measures on psychological and mental well-being of the general population were taken into consideration (Seetan et al., 2021). These inexorable circumstances which are beyond normal experience, lead to stress, anxiety and a feeling of helplessness in all (Shen et al., 2020).

This imposition of the MCO has stranded several thousands of students in their college residencies (Daim, 2020). Being separated from and the looming uncertainty of being reunited with their families could be major sources of students' stress and anxiety (Abdullah, 2020). Beharu (2018), showed that psychological factors such as stress, anxiety, depression, lack of motivation, loneness, helplessness, and phobias, can lead students in higher education institutions to fail in their academic achievements, test anxiety, poor performance, low self-confidence, unrealistic worry and fear or uneasiness that interfere with their ability to function normally.

Figure 1.2 Number of COVID-19 deaths worldwide

The COVID 19 status has resulted in the closure of schools and institutions, as well as the suspension of face-to-face teaching and learning activities. Due to the spread of this COVID-19 and no more physical classes. Many institutions throughout the world have either postponed or cancelled all campus activities in order to reduce crowding and thereby virus transmission. These policies, however, have a greater economic, medical, and social impact on both undergraduate and postgraduate populations (Esposito & Principi, 2020; Nicola et al., 2020).

Nonetheless, the campus closure and movement restriction order had an impact on formal learning, therefore online learning was chosen as the best alternative to continue the learning process. In April 2020, the Malaysian government ordered the students to return to their homeland and continue their studies through online learning (Firm, 2020). Online learning through the use of several devices like computers, laptops, tablets, and mobile phones with internet access in synchronous and asynchronous environments become the alternative learning method (Singh & Thurman, 2019). The students required to adapt themselves to new environmental conditions such as temperature, noise, lighting, and technologies that are different from classrooms at their university.

Specifically, these new environmental conditions can be uncomfortable and have an impact on the students' academic performance (Realyvásquez-Vargas et al., 2020a). Due to limited internet connection, students have trouble connecting with their lecturers, interacting with their friends, and gaining access to laboratories, all of which have an impact on their studies. The classroom climate can be positive or unfavorable to learning achievements (Ximena Patricia et al., 2021).

Mahdy (2020) demonstrated that the COVID-19 pandemic lockdown had variable degrees of impact on most student' academic performance. Some students

have a sense of loneliness, loss of interest, spending a long time in online learning makes the students lose their motivation to participate, also they feel tired with sleeping issues, technical problems and rapid change in the system and environment.

Medical students, who highly depend on clinical experience, may have been affected even more by the epidemic due to the cancellation of clinical training. Because of the pandemic, which led educational institutions to discontinue in-person teaching sessions, medical students were forced to adjust to new learning environments, such as new technology approaches and other classroom environments (Al-Balas et al., 2020). Medical students, in general, have higher levels of psychological impairment in the form of depression, anxiety, and stress than the general population, owing to the high-pressure environment in which they study and train.

This research aims to study the relationship between the environmental factors (lighting, noise, temperature, and technology), psychological health and academic performance among medical students of Universiti Sains Malaysia (USM) during the COVID-19 period in Malaysia. This research is important as examine the factors that influence students' academic performance during the pandemic period. It also provides an insight into the Malaysian university and government in assisting the development of online learning in Malaysia.

1.2 Problem Statement

COVID-19 is therefore seen as a source of additional stress for the general public, particularly healthcare personnel and medical students. Medical students have been reported to be at risk for psychological stress and mental disorders with a significant impact on academic performance (Alnaser et al., 2021; Sundarasan et al., 2020). There are diverse factors that impact the academic performance of the students,

especially during the lockdown and online learning due to COVID-19 (Giusti et al., 2021).

The academic performance of university students might be affected by the environmental conditions (LNT), which they are exposed at home during the COVID-19 pandemic (Realyvásquez-Vargas et al., 2020b). Inadequate online learning infrastructures and limited internet access make online learning more difficult for students (LEE, 2020). Their academic performance being impacted by technical issues with online applications and the difficulty of learning online (Son et al., 2020).

Besides that, the previous studies study did not focus on the relationship between psychological health and other factors like environmental factors (LNT and technology) towards academic performance (Kumar et al., 2019; Realyvásquez-Vargas et al., 2020b).

1.3 Justification of the Study

Students' performance is critical in developing high-quality graduates who will become strong leaders and manpower for the country by overseeing the country's financial and social growth (Ali et al, 2009). Because of the significant responsibility that the profession entails, medical students' education is held in high regard in any country. Students' academic accomplishment reflects their competency in their future vocation. Although students' knowledge, skills, and desirable attitude enhance as they gain experience (Musa & Haque, 2017). It is occasionally considered that there is a disparity in achievement as a result of many factors influencing students' academic performance, especially during the lockdown and online learning due to COVID-19 (Giusti et al., 2021; Son et al., 2020).

Medical students tend to experience great levels of anxiety and depressive symptoms during COVID-19 (Lasheras et al., 2020). As a result, we aim to find out to

what extent psychological health and environmental factors affects academic performance.

Realyvásquez-Vargas et al (2020) showed that the factors (LNT and technology) have significant direct effects on university students' academic performance. Academic performance and good grades are among the key aims at all levels of education, with favourable effects for both students and educational systems. Identifying the factors influencing students' academic success has therefore one of the most critical matters of researchers and educational psychologists (Mega et al., 2014), as well as one of the challenges encountered by medical schools (Artino et al., 2010; Sagheb et al., 2018).

There is a clear lack of studies on psychological disorders that linked to environmental factors (Cianconi et al., 2020). There is also a lack of studies that evaluate the relationship of environmental factors, psychological health and students' academic performance using online learning.

1.4 Significant of the Study

It is important to have a valid and reliable environmental factors questionnaire. This aids in recognising the environmental factors that might influence the students. In addition, the questionnaire could be used to determine factors that affect the academic performance of medical students. Besides that, the prevalence of the psychological disorder among medical students could be determined. It will provide more understanding of the psychological health of students.

This study will identify the relationship of environmental factors, psychological health and academic performance among students who use online learning. It will evaluate the utility and effectiveness of online learning in order to

have a better understanding of the academic performance of medical students during online learning. It helps the academicians to improve online learning activities.

1.5 Research Questions

1. Are the factor structures of the English version of the LNT scale, and technological scale valid and reliable among undergraduate medical students in USM by using confirmatory factor analysis (CFA)?
2. What are the mean scores of environmental factors (LNT and technology) and psychological health among undergraduate medical students taking online learning during the COVID-19 pandemic in USM?
3. Are there any significant path relationships of environmental factors (LNT and technology), psychological health and academic performance among undergraduate medical students taking online learning during the COVID-19 pandemic in USM by using Structural Equation Modelling (SEM)?

1.6 Research Objectives

1.6.1 General Objective

To study the structural relationship of environmental factors (LNT and technology), psychological health and academic performance among undergraduate medical students taking online learning during the COVID-19 pandemic in USM by using SEM.

1.6.2 Specific Objectives

1. To confirm the validity and reliability of the factor structure of the English version of environmental factors (LNT) scale, and technology scale among undergraduate medical students in USM, by using CFA.

2. To determine the mean scores of environmental factors (LNT and technology) and psychological health among undergraduate medical students taking online learning during the COVID-19 pandemic in USM.
3. To determine path relationships of environmental factors (LNT and technology), psychological health and academic performance among undergraduate medical students taking online learning during the COVID-19 pandemic in USM by using SEM.

1.7 Research Hypothesis

1. The English version of environmental factors LNT scale and technology scale are valid and reliable among undergraduate medical students in USM by using CFA.
2. There are significant path relationships of environmental factors (LNT and technology), psychological health and academic performance among undergraduate medical students taking online learning during the COVID-19 pandemic in USM by using SEM.
 - i. There is significant relationship between lighting and academic performance.
 - ii. There is significant relationship between noise and academic performance.
 - iii. There is significant relationship between temperature and academic performance.
 - iv. There is significant relationship between technology and academic performance.
 - v. There is significant relationship between psychological health and academic performance.
 - vi. There is significant relationship between lighting and psychological health.
 - vii. There is significant relationship between noise and psychological health.

- viii. There is significant relationship between temperature and psychological health.
- ix. There is significant relationship between technology and psychological health.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter gives an overview of past literature by providing a complete description of current understanding and knowledge relative to the topics addressed in this study. The initial part covers investigation words and uses databases. Then it covers COVID-19, online learning, environmental factors, psychological health, academic performance, questionnaires and the last conceptual framework.

2.2 Search Terms and Databases

Extensive literature search for journals, theses, books, and articles through electronic databases like Google Scholar, Scopus, PubMed, ScienceDirect, and Core was conducted.

Keywords used in database search were environmental factor, technology, lighting, noise temperature, psychological health, mental health, academic performance, academic achievement, student, university, medical and college. Boolean operators such as “AND” or “OR” were used to combine the keywords such as environmental factor AND academic performance OR academic achievement. Phrase, that encloses all the words in quotes (“”) was used to display Only literature containing this phrase for example “environmental factor” and “academic performance”, “psychological health”.

2.3 COVID-19

COVID-19 is an enclosed positive single-strand RNA virus. It is belonged to the Orthocoronavirinae subfamily, which is characterized by the "crown-like" spikes on its surfaces (Perlman, 2020). The exact origin, source, and natural reservoir of the 2019-nCoV are unknown, while it is thought to be zoonotic and that bats may be to cause due to sequence similarities to the bat-CoV. It could have originated from a kind of wildlife in the wet market. Theoretically, people could become infected if they contact with or eat the reservoir or infected animal (Perlman, 2020; Zhu et al., 2020).

There are a few types of COVID-19 variants. The discovery of these variants showed that the virus was evolving. In August 2020, the Lambda variant was first discovered in Peru. This variant has since spread to at least 29 countries. The Alpha variant was first identified in the UK in September 2020 (Walker et al., 2021). While the Delta variant was first discovered in December 2020 in India (Cascella et al., 2022).

SARS-CoV-2 can be transmitted within 14 days (Quilty et al., 2020; Rothe et al., 2020). The transmission of SARS-CoV-2 occur through respiratory droplets and direct or indirect contact with the eyes, mouth and nose. The symptoms of COVID-19 include fever, dry cough, fatigue, nasal congestion, headache, diarrhoea, sore throat and vomiting (Huang et al., 2020; D. Wang et al., 2020). The symptoms might be different according to type of COVID-19 variants.

2.3.1 Prevention and Control of COVID-19

2.3.1(a) Declaration

WHO named the epidemic a Global Public Health Emergency (Woodward & Neilson, 2020). On January 31, 2020, the US designated nCoV a Public Health Emergency. On March 11, 2020, the WHO declared the COVID-19 outbreak as a global pandemic (WHO, 2020).

2.3.1(b) Restriction

Restrictive measures had shown an effectiveness to prevent and control the spread of the virus. Many countries like the US, UK, France, China and include Malaysia have locked down and quarantined their population (Seetan et al., 2021). Many countries saw a drop in cases, hospitalizations, and deaths due to the restrictions.

In the UK, the first nationwide ‘lockdown’ was imposed on March 23rd, 2020 (Evans et al., 2021). Libya has implemented several restrictive procedures including lockdown measures since March 2020 (Msherghi et al., 2021). Stricter screening procedures was done for feverish travelers at airports in Thailand, Hong Kong, South Korea, and Singapore (Woodward & Neilson, 2020). Many governments reinforce lockdown measures once again after the Delta variant was first discovered in December in India and fueled by a rise in cases in some counties such as the UK.

Malaysia implemented a nationwide Movement Control Order (MCO) on 18th March 2020 (Ministry of Health Malaysia, 2020b). During the MCO, Malaysians were barred from travelling overseas, and inter-and intra-state travel was restricted to only those providing critical services. At the same time, the operation of all educational institutions, government agencies, and non-essential businesses temporarily ceased. These strict control strategies successfully contained the spread of SARS-CoV-2 and flattened the COVID-19 epidemic curve (Chong et al., 2020) and Malaysia entered the recovery MCO (RMCO) phase on 10th Jun 2020 (Ministry of Health Malaysia, 2020c).

MCO 2.0 was implemented on 13th Jan 2021 to curb the spread of the infection (New Strait Times, 2021). The Malaysian Government has announced a MCO 3.0, which is a full lockdown beginning from 1 June 2021 to 14 June 2021. In October 2021, the Malaysian government lifted movement control restrictions

for vaccinated people and announced its intention to treat COVID-19 as an endemic disease (Reuters, 2021).

2.3.1(c) Wearing Mask and Social Distance

Many countries have used quarantine or physical isolation policies to keep their people safe, reduce illness spread, and manage infectious contamination. Short to medium-term lockdowns, voluntary house restrictions, suspension of social and public events, and travel restrictions were all part of the quarantine (Usher et al., 2020). The pandemic could be contained by isolating the infected group of individuals and practicing social distancing, as shown in China (WHO, 2020). On the 6th of April, the WHO released guidance on mask-wearing, as more evidence began to highlight the role of aerosols in the spread of the disease.

2.3.1(d) Vaccine

A vaccine was needed to overcome the pandemic. Vaccinations were developed in record time. Currently, there are few types of vaccines available. On the 17th of March 2020, the first COVID-19 human vaccine trials begin with the Moderna mRNA vaccine. On the 9th of November, trials demonstrated the Pfizer and BioNTech vaccines to be over 90% effective, and the Moderna vaccine was proved to also be effective just a week later on the 16th of November. One more week later, on the 23rd of November, the University of Oxford and AstraZeneca COVID-19 was also shown to be effective.

Finally, on the 31st of December 2020, the WHO issued its first emergency use validation for a COVID-19 vaccine, making the Pfizer/BioNTech vaccine the first to be available for use. The emergency validation was seen as a positive step towards making COVID-19 vaccines globally available in order to end the pandemic. Since then, the Moderna vaccine and the Oxford/AstraZeneca vaccine have also been

approved for use and national vaccine rollout initiatives have begun with full force. As of the 27th of April 2021, 1 billion COVID-19 vaccine doses have been administered. In Malaysia, the National COVID-19 Immunization Program was launched on 24th February 2021 (Carvalho, 2021).

2.3.2 Complications of COVID-19

People with weakened immune systems, such as the elderly and babies, as well as those with a history of other diseases, are more prone to suffer severe consequences after being diagnosed with COVID-19 (Carlos et al., 2020; C. Lu et al., 2020; Xia et al., 2020). China reported its first death on January 11, 2020 (WHO, 2020). With the emergence of these new variants, symptoms and disease outcomes were changing. The Alpha variant may pose a heightened risk of poor COVID-19 outcomes. Cases of COVID-19 began to rise again in many countries and by the 29th of September 2020, there had been 1 million COVID-19 deaths.

2.4 Online learning

Rapid developments in technology have made distance education easy (McBrien et al., 2009). Most of the terms online learning, open learning, web-based learning, computer-mediated learning, blended learning, m-learning have in common the ability to use a computer connected to a network, that offers the possibility to learn from anywhere, anytime, in any rhythm, with any means (Cojocariu et al., 2014).

Online learning can be termed as a tool that can make the teaching-learning process more student-centred, more innovative, and even more flexible (Singh & Thurman, 2019). In these environments, students can be anywhere (independent) to learn and interact with instructors and other students (Singh & Thurman, 2019). Through these learning methods and environments, students have freedom in learning and get connected with their teachers anywhere they want (Singh & Thurman, 2019).

2.4.1 Definition of Online Learning

Online learning is a term that is very difficult to define. Practitioners and researchers have difficulty agreeing on a common definition and terminology for how learning occurs and/or is communicated (J. L. Moore et al., 2011). Online learning is defined as a new paradigm of online learning based on information technology (J. L. Moore et al., 2011), or the most recent version of or new and improved distance learning which improves access to educational opportunities for students (Xu & Jaggars, 2013). It is as learning experiences in synchronous or asynchronous environments using different devices (mobile phones, laptops) with internet access. Online learning is a term that was first used in 1995 when the web-based system WebCT was developed as the first Learning Management System (LMS), which later became Blackboard. Online learning was about using the LMS or uploading text and pdfs online (Bates, 2014).

2.4.2 Type of Online Learning

There are different types of online learning: synchronous, asynchronous, blended, massive online open courses (MOOC), and open schedule online courses (Fidalgo et al., 2020). In synchronous instruction, teachers and learners meet (usually online) for a session at a predetermined time. According to (Watts, 2016) live streaming video and/or audio are used for synchronous interaction. Although video conferencing allows participants to see each other this is not considered a face-to-face interaction because of the physical separation (Keegan, 1980).

Asynchronous instruction means that teachers and learners do not have synchronous sessions and that students have access to course content through the internet at any time they want or need. Communication among the participants occurs mainly through email and online forums and is typically moderated by the instructor (Watts, 2016). According to R. Garrison (2000), synchronous collaborative

learning may well be the defining technology of the postindustrial era of distance education.

Blended learning (BL) was defined by D. R. Garrison & Kanuka (2004) as combining face-to-face classroom time with online learning experiences. Although it is not clear as to how much time is allocated to online in the blended model, the real test of blended learning is the effective integration of the two main components (face-to-face and Internet technology) such that we are not just adding on to the existing dominant approach or method. In the BL format, different teaching strategies and instructional technology can be used to help individuals who have different learning styles, needs and interests (H. Tseng & Walsh, 2016).

MOOC was first introduced in 2006 and offers distributed open online courses that are available without cost to a very large number of participants (Mcauley et al., 2010). MOOCs origins can be traced to the Open Access Initiative in 2002 which advocates sharing knowledge freely through the Internet. By providing educational opportunities MOOCs can address the increasing demand for training and education (Zawacki-Richter & Naidu, 2016).

Open Schedule Online Courses students work asynchronously with all the materials being provided digitally. Although there are deadlines for submitting assignments, students working at their own pace have some independence as to when they do their coursework (Suhonen, 2016).

2.4.3 Online Learning for Medical Students in USM

The normal teaching and learning methods in Phase I are mostly in the form of lectures, practical and problem-based learning. Other methods were also adopted in order to stimulate active learning among the students and sharpen their

communication skills. These methods include seminars, physical examination, self-guided learning, hospital visit, field visit and community placement.

In view of the COVID-19 pandemic and the MCO imposed by the government, a Blended Learning Substitution is carried out. During this period, students learn through online class learning as well as traditional face-to-face teaching. Online class learning is composed of asynchronous and synchronous methods.

Asynchronous refers to any online teaching and learning that occurs without real-time interaction. Examples of asynchronous include using recorded videos/lectures, self-guided learning materials, etc. Elearn@USM platform (<https://elearning.usm.my>) is the university's official e-learning platform used for asynchronous online teaching and learning.

Synchronous online teaching and learning refer to any online teaching & learning that occurs in real-time. Lecturers use online meeting platforms such as Webex, Microsoft Team, Zoom, Google Meet or any other online platforms to conduct the teaching sessions with students. The students can interact or ask questions and lecturers can respond in real-time.

2.5 Environmental Factors

2.5.1 Lighting

At all stages of education, the importance of good lighting conditions (visual comfort) has been emphasized (Barrett et al., 2015; Bluysen et al., 2018; Giuli et al., 2014; Winterbottom & Wilkins, 2009) to university faculties (Leccese et al., 2020; Yang et al., 2013).

Different forms of light are used in different areas of the study. During the day, students may be lighted by natural light through windows and augmented with artificial light sources, with artificial illumination continuing throughout the night (X. Lu et al., 2019). For visual performance and safety, adequate illumination is required.

Natural lighting is synonymous with daylighting, which occurs when light is transferred through sunshine, reflected on a surface, and subsequently illuminates an area or place. In most buildings, daylight is a helpful light source, particularly in learning environments such as classrooms, where the quality of natural light is superior to that of any artificial lighting. Artificial lighting is required to create a safe and suitable learning environment for students. Artificial light production is quickly increasing around the world to meet the demand for various types of lighting, light colours, and human quality of life. In addition, humans have developed a variety of high-tech lighting designs that can produce a variety of wavelengths and light patterns to fulfil their needs (Norazman et al., 2018).

Light is also quite important for one's health and well-being through the regulation of bodily functions (Bommel & Beld, 2016; Boubekri, 2007). The neurological and endocrine systems, as well as the secretion of hormones like melatonin, are all affected by light (Bommel & Beld, 2016). There is evidence that the quality of room lighting impacts students' learning (Winterbottom & Wilkins, 2009). Insufficient lighting, particularly in learning spaces, can diminish a student's capacity to study owing to eye strain, resulting in a loss of information and elevated stress levels (Liberman, 1991). The quality of room lighting also impacts students' performance. Study showed that a favourable learning environment by good lighting in the learning space improved students' overall performance (Leder et al., 2016).

In Mexico, this study was conducted during the quarantine period to examine the environmental factors that affect university students, the results showed that the

mean score of lighting was 11.88 by using QEOC questionnaire (Realyvásquez-Vargas et al., 2020).

2.5.2 Noise

Noise pollution is a major environmental problem. It is defined as an undesired sound that could give negative effects on a person both physically (such as hearing loss) and psychologically (such as frustration and nuisance). Noise becomes a global problem which has been examined extensively around the world (Rey Gozalo et al., 2016). Noise in the classroom can cause a variety of problems in students' hearing, communication and intelligence (Shield & Dockrell, 2003). Excessive noise is detrimental to the teaching-learning process because it is distracting, limits attention and cognition. It makes it more difficult for pupils to hear and understand the teacher's speech (Filho et al., 2014; Kooijman et al., 2007).

Besides that, long-term and recurrent noise exposure can have a negative impact on students' psychological health as well as their motivation to learn in class (Wulandari - Jurnal Kesehatan, 2007). Noise in the classroom can be disruptive to students' moods for a variety of reasons (Shield & Dockrell, 2003).

The relationship of noise pollution with stress and other diseases are also well established on a biochemical basis, leading to elevated levels of stress hormones such as cortisol (Behzad Fouladi et al., 2012) and dopamine (Di & He, 2013).

Using the QEOC questionnaire, this study was conducted in Mexico during the quarantine period to assess the environmental factors that affect university students. The results revealed that the mean score for noise was 9.95 (Realyvásquez-Vargas et al., 2020).

2.5.3 Temperature

A comfortable temperature is defined as the state of mind, which expresses satisfaction with the thermal environment (Puteh et al., 2012). It is also the most crucial factor in establishing total satisfaction with indoor environmental quality (Frontczak & Wargocki, 2011). The tropical climate in Malaysia is hot and humid. This environment may have an impact on air temperature, causing dissatisfaction and unhappiness among students, causing them to feel uncomfortable and so affecting their productivity (Kamaruzzaman & Samsul Bin Mohd Tazilan, 2013).

Data acquired by Department of Information (2016) showed that outdoor temperatures are very consistent, ranging 21°C and 32°C on average throughout the day. According to Hussein & Rahman (2009), the acceptable temperature ranges from 27.1 to 29.3°C. Another study mentioned the maximum acceptable temperature is 26.5°C (Kamaruzzaman & Samsul Bin Mohd Tazilan, 2013). Thermal discomfort caused by elevated classroom temperatures has been demonstrated to affect students' ability to accomplish standard academic tasks (Bakó-Biró et al., 2012; Porras-Salazar et al., 2018). Heat stress caused by high outside temperatures has been found to increase the number of students failing tests (Park et al., 2020).

According to few studies, negative thermal effects on performance are much greater for less able students (Porras-Salazar et al., 2018). One possible explanation for the observed impacts is that students cannot concentrate or are distracted when classroom temperatures are excessively high, which has detrimental consequences for an effective learning process (Wargocki et al., 2013). O. Seppänen (2006) indicated that performance will decrease below 21–22°C and above 23–24 °C, and that optimal performance would be around 22°C. In the temperature range of 24–32°C, the change in performance was around a 1% drop for every 1 °C rise in temperature.

This study was conducted in Mexico during the quarantine period using the QEOC questionnaire to investigate the environmental factors that affect university students. The mean temperature score was 11.48, according to the findings (Realyvásquez-Vargas et al., 2020).

2.5.4 Technology

The technological factor is one of the instrumental aspects influencing the success of online education (Almaiah, 2018). Online technologies can enhance the learning experience by doing more than what can be done in face-to-face or other techniques (Smart & Cappel, 2006). One of the most critical elements influencing student satisfaction and performance is access to technology (Belanger & Jordan, 2013). Students must have access to reliable equipment (Naaj et al., 2012).

Inadequate online learning infrastructures and limited accessibility to the internet make the online learning process harder for the students (LEE, 2020). Students with limited access are at a significant disadvantage when compared to students with unlimited access (R Wegerif, 1998). To be successful, online students must be familiar with the technologies utilized in the course (Belanger & Jordan, 2013). Students who are dissatisfied with the course's technology report lower levels of satisfaction and performance. Students who do not have enough technological help have also reported high levels of frustration in the online environment (N. Hara, 2003).

A study conducted among Ghana students during online education faced technological problems with connectivity (Agormedah et al., 2020). While another study on online classes also reported that 31.60% of students had electricity problem and 11.50% rated internet connectivity as bad (Tuladhar et al., 2020).

A study among nursing students in Nepal reported more than half of the students (63.2%) had disturbances in online classes due to electricity problems and

63.6% due to internet problems (Thapa et al., 2021). Another study in Nepal, was conducted to assess satisfaction towards online learning reported the total mean with SD score of technology was 24.8(4.2) among Chitwan Medical College students (Sharma et al., 2020).

This study was conducted in Malaysia during the quarantine period to assess the experience of students at higher learning institutions with the implementation of online learning. The results revealed that the mean technology score was 20.22 using the SSSF questionnaire (Selvanathan et al., 2020).

2.6 Psychological health

2.6.1 Introduction

Psychological health is a state of well-being in which an individual recognizes his or her own abilities, seems to be able to cope with normal life pressures, can work productively and fruitfully, and can contribute to his or her community (Herrman et al., 2005); (Organization, 2004).

Psychological distress is an unpleasant, negative state in which coping and adaptive mechanisms fail to restore physiological and psychological balance. (Carstens & Moberg, 2000). It is also defined as “the unique discomforting, emotional state experienced by an individual in response to a specific stressor or demand that results in harm, either temporary or permanent, to the person.” (Ridner, 2004). It is the exposure to a stressful event that affects physical or mental health, the inability to manage effectively with this stressor, and emotional chaos that result from this ineffective coping (Drapeau & Marchand, 2012; Horwitz, 2007). Saïas et al (2014) defined it as a state of emotional suffering characterized by the symptoms of depression and anxiety.

There are many symptoms of psychological problems such as depression, anxiety, stress, posttraumatic stress disorder, insomnia, and loneliness (A. Irawan et al., 2020; Thandavaraj et al., 2021).

2.6.2 Psychological Health among Medical Students

During the COVID-19, psychological health problems, especially depression, anxiety, and stress are common among students especially medical students (Zhou et al., 2020). The findings indicated that medical students were more likely to experience academic stress than non-medical students were expected, given the more severe study demands compounded by additional background concerns in a medical program compared to other programs (Chattu et al., 2020). Saravanan et al (2020) reported that 51% of students in the United Arab Emirates (UAE) have psychological distress. According to Moy & Ng (2021) the levels of stress, anxiety and depression were 56.5%, 51.3%, and 29.4% respectively, among university students in Malaysia.

Medical students, in general, have higher levels of psychological impairment in the form of depression, anxiety, and stress than the general population, owing to the high-pressure environment in which they study and train. In turn, COVID-19 is viewed as an extra source of stress for medical students. (Moir et al., 2018; Pandey et al., 2021; Quek et al., 2019). In meta-analysis stud, showed the physicians, nurses, and non-medical staff have a higher prevalence of insomnia ($Q = 196.64$, $p < 0.01$) than other populations (Wu et al., 2021).

Cao et al (2020) reported 0.9% of the medical students were experiencing severe anxiety, 2.7% moderate anxiety, and 21.3% mild anxiety in China during the COVID-19 pandemic. The prevalence of depression, stress, and anxiety was 69.57%, 60.87%, and 99.04%, respectively in Iranian medical students (Moayed et al., 2021). Out of 1027 medical students, 44.6% had stressed, 47.8% had anxiety, and 18.6% had depression (Natalia & Syakurah, 2021). The overall mean GHQ-12 score among