RELATIONSHIP BETWEEN MOOD STATES, EXERCISE BEHAVIOUR, COPING AND MENTAL HEALTH AMONG MALAYSIAN DURING COVID-19 PANDEMIC BY USING PATH ANALYSIS

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LIST OF ABBREVIATIONS AND SYMBOLS

BRUMS	Brunel Mood Scale
BREQ-3	Behavioural Regulations in Exercise Questionnaire-3
Brief COPE	Brief Coping Orientation of Problem Experienced
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CI	Confidence Interval
CMCO	Conditional Movement Control Order
COVID-19	Corona Virus Disease 2019
CR	Critical Ratio
DASS-21	Depression, Anxiety and Stress
df	Degree of Freedom
EFA	Exploratory Factor Analysis
KMO	Kaiser-Meyer-Olkin Measure
HREC	Human Research Ethics Committee
IQR	Interquartile Range
MAR	Missing at random
MCAR	Missing completely at random
MCO	Movement Control Order
MI	Modification Index
ML	Maximum Likelihood
MLM	Maximum Likelihood Method
MLR	Robust Maximum Likelihood
MNAR	Missing not at random
RMCO	Recovery Movement Control Order
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
SARS	Severe Acute Respiratory Syndrome
SD	Standard Deviation
SE	Standard Error

SEM	Structural Equation Modelling
SRMR	Standardised Root Mean square residual
TLI	Tucker-Lewis index
USM	Universiti Sains Malaysia
WHO	World Health Organization
WRMR	Weighted root square mean square residual
%	Percentage
A	Significance Level
N	Sample size/ Total participants
β	Standardised Path Regression Coefficient
P	Probability Value
X^2	Chi-square
H	Hypothesis
AH	Additional Hypothesis

PERHUBUNGAN ANTARA EMOSI, TINGKAH LAKU BERSENAM, DAYA TINDAK DAN KESIHATAN MENTAL DALAM KALANGAN RAKYAT MALAYSIA SEMASA PANDEMIK COVID-19 DENGAN MENGGUNAKAN ANALISIS LALUAN

ABSTRAK

Penyakit Coronavirus atau COVID-19 adalah jangkitan serius yang tidak hanya memberi kesan kepada kesihatan fizikal, tetapi juga memberi kesan kepada keadaan emosi, tingkah laku bersenam dan daya tindak yang seterusnya mempengaruhi status kesihatan mental dalam kalangan rakyat Malaysia semasa pandemik COVID-19. Kajian ini bertujuan untuk menentukan hubungan keadaan emosi, tingkah laku bersenam, daya tindak dan kesihatan mental dalam kalangan rakyat Malaysia dengan menggunakan analisis laluan dan perubahannya dari Fasa gelombang-2 ke gelombang-3 pandemik COVID-19. Kajian keratan rentas telah dilakukan dengan menggunakan soal selidik yang diisi sendiri oleh peserta melalui tinjauan dalam talian. Kaedah pensampelan bola salji dan mudah telah digunakan untuk memilih responden semasa tinjauan Fasa gelombang-2 dan gelombang-3 pandemik COVID-19 masing-masing. Kementerian Kesihatan Malaysia mengumumkan Fasa gelombang-2 kes COVID-19 bermula pada 27 Februari 2020 dan Fasa gelombang-3 kes COVID-19 dinyatakan pada 20 September 2020. *Brunel Mood Scale (BRUMS), Exercise Regulations in Exercise-3 (BREQ-3), Brief Coping Orientation of Problem Experienced (COPE)* and *Depression, Anxiety and Stress Scale (DASS-21)* versi Melayu telah digunakan. Analisi laluan dan ujian t berpasangan telah dilakukan untuk analisi statistik. Seramai 842 dan 329 responden telah mengambil bahagian dalam kajian semasa gelombang-2 dan gelombang-3 masing-masing. Model laluan muktamad menunjukkan bahawa model ini mempunyai padanan yang bagus

dengan data sampel kajian: *Comparative Fit Index* (CFI) = 0.998, *Tucker-Lewis Index* (TLI) = 0.988, *Standardised Root-Mean Square Residual* (SRMR) = 0.001, *Root Mean Square Error of Approximation* (RMSEA) (90%CI) = 0.072 (0.056, 0.088), RMSEA nilai p = 0.012. Terdapat hubungan diantara laluan yang bererti antara emosi, tingkah laku bersenam, daya tindak dan kesihatan mental, dengan jumlah 36 laluan yang disokong dan bererti secara statistik, dan tambahan lima laluan baru yang bererti secara statistik dan penting secara teori. Emosi, tingkah laku senaman, dan daya tindak juga terbukti mempunyai kesan langsung dan tidak langsung terhadap kesihatan mental. Di samping itu, kajian mendapati perbezaan min yang bererti diantara skor gelombang-2 dan gelombang-3 bagi emosi negatif, peraturan introjeksi, peraturan bersepadu, peraturan intrinsik dan kemurungan. Hasil kajian ini melaporkan kesihatan mental dapat ditingkatkan dengan menningkatkan emosi, tingkah laku bersenam dan daya tindak (secara langsung dan tidak langsung). Terdapat juga perubahan yang bererti diantara Fasa gelombang-2 dan gelombang-3 pandemik COVID-19 bagi pembolehubah emosi, tingkah laku bersenam dan kesihatan mental. Oleh itu, maklumat yang diperoleh adalah sangat penting bagi membuktikan maklumat yang tepat, dan seterusnya untuk merancang intervensi untuk meningkatkan tahap kesihatan mental.

Kata kunci: *emosi, tingkah laku bersenam, daya tindak, kesihatan mental, pandemik COVID-19, analisis laluan*

RELATIONSHIP BETWEEN MOOD STATES, EXERCISE BEHAVIOUR, COPING AND MENTAL HEALTH AMONG MALAYSIAN DURING COVID-19 PANDEMIC BY USING PATH ANALYSIS

ABSTRACT

Coronavirus disease or COVID-19 is a serious infection that not only make an impact on physical health, it also affects mood states, exercise behaviour and coping which in turn to affect mental health status among Malaysian during COVID-19 pandemic. This study is aimed to determine the relationship of mood state, exercise behaviour, coping and mental health among Malaysian by using path analysis and their changes from Wave-2 to Wave-3 phases of COVID-19 pandemic. A cross-sectional study was conducted using self-administered questionnaires via an online survey. Snowball sampling and convenience sampling method were used to recruit respondents during Wave-2 and Wave-3 survey, respectively. Ministry of Health Malaysia announced the second wave of COVID-19 cases started on 27 February 2020 and third wave started on 20 September 2020. The questionnaires of Brunel Mood Scale (BRUMS), Exercise Regulations in Exercise-3 (BREQ-3), Brief Coping Orientation of Problem Experienced (COPE) and Depression, Anxiety and Stress Scale (DASS-21) were used. Path analysis and paired t test were conducted for statistical analyses. A total of 842 and 329 respondents participated in the survey during Wave-2 and Wave-3, respectively. The final path model revealed path model has a good fit: Comparative Fit Index (CFI) = 0.998, Tucker-Lewis Index (TLI) = 0.988, Standardised Root-Mean Square Residual (SRMR) = 0.001, Root Mean Square Error of Approximation (RMSEA) (90%CI) = 0.072 (0.056, 0.088), RMSEA p-value = 0.012. There were significant path relationship between mood, exercise behaviour, coping and mental health, with total of 36 paths were supported and statistically significant, and additional five new paths were statistically significant and theoretically important. The

variables mood, exercise behaviour and coping were also showed to have direct and indirect effects on mental health. Besides, the study revealed that there were significant mean difference between Wave-2 and Wave-3 on negative mood, introjected regulation, integrated regulation, intrinsic regulation and depression scores. Findings of this study reported that mental health may be improved by enhancing mood, exercise behaviour and coping (directly and indirectly). There are also significant changes between Wave-2 and Wave-3 among the variable mood, exercise behaviour and mental health. Therefore, the information obtained would be crucial for proving accurate information in turn to develop an intervention plan to improve mental health status.

Keywords: *mood, exercise behaviour, coping, mental health, COVID-19 pandemic, path analysis*

CHAPTER 1

INTRODUCTION

1.1 Background

In Wuhan, Hubei Province, China reported many unexplained cases like pneumonia in late December 2019. Wuhan was the first city that reported the coronavirus cases in China and is spreading quickly throughout the world, posing a huge threat and posing serious challenges to population health globally (Zhu *et al*., 2020). The exposure to a seafood market in Wuhan was related to the majority of the cases. On 11 February 2020, the WHO named it Corona Virus Disease 2019 (COVID-19) (WHO, 2020). COVID-19 has further declared as pandemic by WHO in March 2020 because of the growing number of cases in over 200 countries and territories.

COVID-19 can be transmitted via human-to human interaction via virus-laden respiratory droplets (Thompson, 2020). COVID-19 pandemic has a high transmissibility rate based on its reproductive number, which is estimated to be 4.08 (Cao *et al*., 2020). This means that each COVID-19 patient would generate up to four new patients on average. Fever, chills, cough, sore throat, trouble breathing, vomiting, nausea, and coryza are all signs of infection (Chen, 2020). COVID-19 has an average incubation period of 5.2 days, with some difference between 2 and 14 days among diagnosed patients (Li, 2020). The disease is also believed to be capable of asymptomatic spread (Rothe, 2020; Ryu and Chun, 2020) which became a challenge for preventing the further exposure of COVID-19 in many countries.

COVID-19 can infect people of all ages, but it causes severe illness in older adults the most and individuals who have medical problems (Li *et al*., 2020). At the time, there were no

clear COVID-19 drugs, vaccines, or treatments available. According to WHO, the temporary case fatality rate is about two percent, although some researchers estimate it to be between 0.3 and 0.6 percent. The COVID-19 outbreak makes a huge impact on human wellbeing because of the high transmission rate, serious infection effects, and unpredictable pandemic period (Li *et al*., 2020).

The Malaysia government introduced mitigation programs for controlling the spread of coronavirus. Mitigation programs included quarantining reported cases, monitoring and restricting suspicious cases by house arrest, closing colleges, and encouraging people to stay at home (Hellewell *et al*., 2020). These interventions have the potential to stop the virus from spreading. However, they have the potential to make a severe impact on psychological status (Brooks *et al*., 2020). People's behaviour must be limited and regulated for a long period of time in order to avoid and monitor the pandemic situation, which can affect their everyday lives, careers, and studies. Furthermore, these prevention strategies may result in being suffered, irritable, bored, feeling inability to protect themselves, or lack of hope (Li *et al*., 2020). Rajkumar (2020) study also reported distress, anxiety, and depression increased psychological pressures during this pandemic outbreak.

The pandemic outbreak causes a psychological impact that is linked to behavioural changes. An online survey result reported having prevention behaviours such as washing hands frequently and keeping social distance with each other are the reactions of fear about COVID-19 pandemic for the public practicing the behaviours (Harper *et al*., 2020). Other than pandemic affects psychologically on behavioural changes, awareness of COVID-19 and related protection strategies also influence behavioural changes associated with the pandemic. Moreover, dysfunctional behaviour includes stockpiling is associated with lower knowledge about COVID-19 (Clements, 2020).

The COVID-19 pandemic has caused fear and anxiety and there is an urgently to understand the mental health status in the outbreak communities. This is because novel or exotic threats trigger higher levels of anxiety than threats that are more common (Coughlin, 2012). Mental health issues associated with COVID-19 pandemic, as well as appropriate behaviours to adopt to avoid mental health threats due to the infection are rarely investigated on timely manner. It is also unclear whether coping behaviours are increased as a method to cope with the crisis in the outbreak population.

Other more practical behaviour such as exercise behaviour could be a means to cope with negative emotions during a new pandemic crisis. Saxon *et al*. (2016) and Zhou *et al*. (2017) studies reported coping was associated with mental health. Besides, Ivanova *et al*. (2017) and Zayed *et al*. (2018) determined exercise behaviour was related to mental health. There is an association between an individual's mood, exercise behaviour, and coping (Santiago *et al*., 2016). However, very limited studies have investigated this association during a disease outbreak such as COVID-19.

To improve our understanding of Malaysia's public reaction to the COVID-19 outbreak, the present study examines temporal relationships state of mood, coping, and exercise behaviour towards their mental health during the COVID-19 crises. It is hypothesized that the adoption of exercise and coping behaviours are associated with mental health during outbreak crisis. Mood state affects one's behaviours and mental health. The results of the present study will increase public awareness regarding psychiatric events and offer preventive measures and support in making effective decisions to reduce panic among the communities.

1.2 Problem Statements

COVID-19 is extremely infectious, which spreads rapidly and can be lethal in extreme cases Lack of specific treatments poses a serious threat to individuals' lives and wellbeing, and also has a significant effect on their psychological responses and coping skills (Huang and rong Liu, 2020). Researchers have revealed that great psychological stimuli are always caused by public health emergencies and disasters to those affected. When a stimulus reaches a person's general psychological response level, serious effects such as psychological, physiological, and behavioural alterations (Huang and Zhao, 2020). Nevertheless, a pandemic's occurrence is unpredictable in terms of time and space, which affects individuals' mentality, feeling insecure, depression, anxiety, stress, tension, confused and even feeling lack of hope (Rubin *et al*., 2010; Wang *et al.,* 2020).

Pandemics can also cause fear, anxiety, and tension, which can lead to mental health problems such as depression, suicide, and acute stress disorder post-traumatic stress disorder. During public health crises, individuals become more sensitive, and they will fear uncertainty and terrifying new disease might transform into dangerous skepticism (Jin *et al*., 2020). In 2018, it was projected that the next big outbreak will not be caused by a lack of prevention technology, but by emotional contagion, which could erode confidence in government and trigger significant economic and social disruption (Larson, 2018).

Therefore, government implemented Movement Control Order (MCO) throughout Malaysia for controlling the outbreak. First day of MCO started on 18 March 2020. All offices, schools, universities, shops, companies were closed throughout Malaysia in line with the MCO instead of food markets. During this period, all Malaysia population will operate fully on a work-from-home basis. During the outbreak, the postponement of school openings was announced by colleges and universities, which is an effective way for pandemic control (Wang

et al., 2020a). Individuals' negative feelings are exacerbated because the schools and shops are closed (Van Bortel *et al*., 2016).

The Ministry of Health (MoH) Malaysia extended the MCO due to the further increasing of cases. After that, the MCO converted to Conditional Movement Control Order (CMCO) and Recovery Movement Control Order (RMCO) when the cases decrease. These implementations affected the daily activity participation at different locations (Shah *et al*., 2020). The first wave of COVID-19 was announced in Malaysia. The distribution of MCO, CMCO, and RMCO based on the number of cases in the first wave of COVID-19 (Ali *et al*., 2021). Moreover, the cases were then decreased, increased, and then decreased again which was stated into second wave and third wave of COVID-19. Participation in a wide variety of (research and physical) activities on a particular day affects Malaysians' health parameters (physical, social, and mental) (Yau *et al*., 2020). Participating in exercise persistently achieve the long-term physical and psychological benefits of exercise. Drop-out from exercise programmes could be partly attributed to the regulation underlying exercise behaviour. The changes of mood states, exercise behaviour, coping and mental health status is different over the time periods (wave changes) of COVID-19 pandemic in Malaysia. There is important to determine the changes among the variables between wave changes of COVID-19 pandemic.

Isolation is one of the widely suggested and legally implemented steps, not only for those who have contracted the virus or come into touch with a reported repeated outbreak, and also for the society that is advised to stay at home and keep isolated from others. These interventions will have the expected effect and result, but their feasibility and manner of implementation have been questioned (Rodgers, 2020). Isolation also brings an impact on mood states and psychological responses (Friedler *et al*., 2015).

Additionally, social distancing is another protective measure for society to prevent virus attacks through contact transmission. However, it is a psychosocial problem in and of itself, with the potential to make worsen mental health issues include depression and anxiety (Huremovic, 2019), and cause sleep disruption (Altena *et al*., 2020). Moreover, quarantine and lockdown measures not only weaken human relationships but also can trigger a revolution in one's behaviours and lifestyles, such as the ability to stay physically involved while being isolated (Chirico *et al*., 2020). In the other words, prolonged staying at home ("quarantine") can be related to sedentary behaviours (sitting, watching television, using smart devices), poor physical activity, and engaging in avoidance activities, all of which may raise the risk of and worsening chronic health conditions (Gutin *et al*., 2005).

During an outbreak of infection, individuals can experience a variety of psychological effects individually, generally, and internationally. An individual will have negative feelings and negative thoughts easily like fear of getting sick or died (Hall *et al*., 2008). A survey conducted among 4,872 Chinese citizens revealed high depression and anxiety levels (Gao *et al*., 2020). Other than that, Qiu *et al*. (2020) also found during the rising period of the outbreak, psychological and behavioural responses to COVID-19 were dramatic.

There is currently no information available about the psychological effects and mental health among Malaysians when COVID-19. There is also lack of information given that general population how to cope with the wave changes of COVID-19. Most of current outbreak research concerns on determining the virus (Lu *et al.*, 2020), the infected patients (Chen *et al*., 2020; Huang *et al*., 2020), and the problems faced by global organisation (Rubin and Wessely, 2020). However, moods consist of a complex combination and feeling which exert influence on exercise behaviour (Quartiroli *et al*., 2017). Therefore, there is also no research to determine the mood influences on exercise behaviour, psychological impact, and its coping strategies affect exercise behaviours among general population in Malaysia.

1.3 Significance of the study

COVID-19 is spreading asymptomatically throughout Malaysia. The Malaysia government announced the implemented pandemic prevention and control measures such as quarantine, closing of schools, universities, and business to reduce concentration of personnel and avoid the spread of the disease. Post-traumatic stress disorder (PTSD), confusion, and frustration are all possible side effects of quarantine (Brooks *et al*., 2020). When faced with unpredictable circumstances such as the COVID-19 outbreak, it can be felt nervous, tension, worry or angry with others' emotions commonly. Wang *et al*. (2020) and Xiang *et al*. (2020) showed general population have all been subjected to physical and mental distress during the outbreak.

Psychiatric illnesses are spreading widely in developing countries (Azad *et al*., 2017). Furthermore, university students were found that they are the highest risk group of developing depression and anxiety symptoms since they are subject to a variety of stressors that are particular to this stage of development (Drake *et al*., 2016). They may have feelings like fear of getting ill, extended period of the outbreak, study problems and family financial loss problems (Li *et al*., 2020).

The difficult job for government is to clarify danger and advise people about how to respond without raising alarms. People with higher anxiety levels, for example, were more likely to overreact to policies. People nowadays receive a great deal of information via social networks, which may make them feeling stress (Qiu *et al*., 2020). People feel stress, fear, and nervousness when number of confirmed and suspected cases increase, as well as the disease trend in the media (Li *et al*., 2020). Because of the restrictions on personal information, people can pay too much attention to COVID-19 media reports about possible causes and trigger their severity, making themselves suffer from stress (Rubin and Wessely, 2020). People who more likely to receive disease-related materials which are deviated, as a result in the spread of

pandemic outbreak information from different sources, such as catastrophic disease cognition, a high sense of self-risk, and an underestimating of their ability to cope, all these will bring psychological impact (Li *et al*., 2020).

Moreover, individuals that are vulnerable to unpleasant emotional contagion were more likely to adopt social values that disagree with government advice or legislation, jeopardising public health initiatives (Aral and Walker, 2012; Ferrara and Yang, 2015). In a similar way, it is unclear whether preventive behaviours are increased because of the coping with negative emotion (Qian *et al*., 2005). Thus, the public health authorities have the need for monitoring mental health information in the event of an actual pandemic. The investigation for the uncertain relation between crisis management and psychological response is a must.

Increasing significantly in depression level during second wave compared to the first wave of the survey had been shown in central China from January 31st to February 9th (first wave of the survey, T1) and March 28th (second wave of the survey, T2), which covered the time from the peak of the outbreak to the remission of COVID-19 epidemic (Duan *et al.*, 2020). New information was also provided in another China study on changing trends of mental responses and prevention patterns from the COVID-19 epidemic (wave1 to wave 5) as the transition to a sporadic infection period (wave 6 and wave 7) (Peng *et al*. 2021). Higher scores of depression, anxiety and stress had also been related to reduced exercise duration during the pandemic (Stanton *et al.*, 2020). In addition, mood scores had been shown that there is fluctuation over time (Terry *et al*., 2020). Therefore, it is crucial to conduct a two-wave study to determine any changes in mood state, exercise behaviour, coping and mental health status among Malaysian during COVID-19 pandemic.

This study could improve our understanding of public reaction to pandemic outbreaks. This will be the first study to examine the temporal relationship of mood, exercise behaviour,

coping and mental health among Malaysia population during pandemic COVID-19. Through this study, we may increase the understanding of how exercise behaviour and coping skills affect the mental health state. In addition, this study may also provide valuable information about how individuals mood state can impact on their exercise, and how the coping, exercise behaviours influence the mental health status. The study's outputs may able for providing the health care organisations, health educators and universities the appropriate behaviours intervention incentive among their communities to prevent mental health crisis during novel disease outbreak.

1.4 Research question

1. What are the level of mood state, exercise behaviour, coping and mental health status among Malaysian during COVID-19 pandemic?
2. Are there any significant path relationships between the mean scores of mood state, exercise behaviour, coping and mental health among Malaysian during COVID-19 pandemic by using the path analysis?
3. Are there any mean difference between mood state, exercise behaviour, coping and mental health scores over two time points [Wave-2 and Wave-3] among Malaysian during COVID-19 pandemic?

1.5 Research objectives

1.5.1 General objectives

To determine the relationship of mood state, exercise behaviour, coping and mental health among Malaysian by using path analysis and their changes from Wave-2 to Wave-3 during COVID-19 pandemic.

1.5.2 Specific objectives

1. To determine the level of mood state, exercise behaviour, coping and mental health status among Malaysian during COVID-19 pandemic.
2. To determine the path relationships between the mean scores of mood state, exercise behaviour, coping and mental health among Malaysian during COVID-19 pandemic.
3. To determine the mean difference between mood state, exercise behaviour, coping and mental health scores over two time points [Wave-2 and Wave-3] among Malaysian during COVID-19 pandemic.

1.6 Research hypothesis

1. There are significant path relationships between the mean scores of mood state, exercise behaviour, coping and mental health among Malaysian during COVID-19 pandemic by using path analysis.
2. There are significant mean difference between mood state, exercise behaviour, coping and mental health scores over two time points [Wave-2 and Wave-3] among Malaysian during COVID-19 pandemic.

Table 1.1 Hypotheses in Initial model (Model 1)

Hypothesized Association
Approach coping is significantly associated with amotivation.
Approach coping is significantly associated with external regulation.
Approach coping is significantly associated with introjected regulation.
Approach coping is significantly associated with identified regulation.
Approach coping is significantly associated with integrated regulation.
Approach coping is significantly associated with intrinsic regulation.
Approach coping is significantly associated with depression.
Approach coping is significantly associated with anxiety.
Approach coping is significantly associated with stress.
Avoidant coping is significantly associated with amotivation.

To be continued...

Hypothesized Association
Avoidant coping is significantly associated with external regulation.
Avoidant coping is significantly associated with introjected regulation.
Avoidant coping is significantly associated with identified regulation.
Avoidant coping is significantly associated with integrated regulation.
Avoidant coping is significantly associated with intrinsic regulation.
Avoidant coping is significantly associated with depression.
Avoidant coping is significantly associated with anxiety.
Avoidant coping is significantly associated with stress.
Religion and humor are significantly associated with amotivation.
Religion and humor are significantly associated with external regulation.
Religion and humor are significantly associated with introjected regulation.
Religion and humor are significantly associated with identified regulation.
Religion and humor are significantly associated with integrated regulation.
Religion and humor are significantly associated with intrinsic regulation.
Religion and humor are significantly associated with depression.
Religion and humor are significantly associated with anxiety.
Religion and humor are significantly associated with stress.
Positive mood is significantly associated with amotivation.
Positive mood is significantly associated with external regulation.
Positive mood is significantly associated with introjected regulation.
Positive mood is significantly associated with identified regulation.
Positive mood is significantly associated with integrated regulation.
Positive mood is significantly associated with intrinsic regulation.
Negative mood is significantly associated with amotivation.
Negative mood is significantly associated with external regulation.
Negative mood is significantly associated with introjected regulation.
Negative mood is significantly associated with identified regulation.
Negative mood is significantly associated with integrated regulation.
Negative mood is significantly associated with intrinsic regulation.
Amotivation is significantly associated with depression.
Amotivation is significantly associated with anxiety.
Amotivation is significantly associated with stress.
External regulation is significantly associated with depression.
External regulation is significantly associated with anxiety.
External regulation is significantly associated with stress.
Introjected regulation is significantly associated with depression.
Introjected regulation is significantly associated with anxiety.
Introjected regulation is significantly associated with stress.
Identified regulation is significantly associated with depression.
Identified regulation is significantly associated with anxiety.
Identified regulation is significantly associated with stress.

To be continued...

Hypothesized Association
Integrated regulation is significantly associated with depression.
Integrated regulation is significantly associated with anxiety.
Integrated regulation is significantly associated with stress.
Intrinsic regulation is significantly associated with depression.
Intrinsic regulation is significantly associated with anxiety.
Intrinsic regulation is significantly associated with stress.

1.7 Operational definition

Path analysis	
Path analysis is an SEM family member that can evaluates models that only concern effects among observed variable in SEM (Kline, 2011). Analysing the relationships among observed variables by using path analysis (Wang and Wang, 2019). Path analysis can be used to define and test structural models including associations and direct or indirect effects between observed variables (Kline, 2011). In this study, path analysis is defined for determining the path relationship between mood state, exercise behaviour, coping and mental health during COVID-19 pandemic.	
Mood	
Mood is defined as a complex and "non-specific" psychological tendency to assess, perceive, and act to past, present or potential issues is referred to as a transient state of mind or feeling (Parkinson *et al*., 1996). In the present study, mood is defined as one's feeling at a particular time.	
Positive mood	Positive mood is defined as alertness and energize feeling (Ismail *et al*., 2017). The component of positive mood is vigor.
Negative mood	Negative mood is meant by feelings of worthlessness and hopelessness (Ismail *et al*., 2017). The component of negative mood is tension, depression, anger, fatigue and confusion.
Exercise behaviour	
How often people have engaged in any physical activity over time (Rodgers *et al*., 2001). In this study. exercise behaviour reflects the way in which one acts towards exercise.	

Amotivation	Amotivation is described as a general lack of motivation in physical activity engagement because of discouragement (Deci and Ryan, 2000).
External regulation	External regulation is described as being physically active in order to escape criticism or receive external praise (Deci and Ryan, 2000).
Introjected regulation	Introjected regulation refers to the source of motivation through feelings of guilt (Deci and Ryan, 2000).
Identified regulation	Identified regulation means anticipating the role of physical activity in one's own life (Deci and Ryan, 2000).
Integrated regulation	Integrated regulation, in which physical activity is brought into line with other dominant life values, making being involved a priority in one's lifestyle (Deci and Ryan, 2000)
Intrinsic regulation	Intrinsic motivation is when someone engages in physical activity because it is relaxing or pleasant in and of itself (Deci and Ryan, 2000).
Coping	
Coping means changing the stressful situation or controlling their emotional responses (Folkman and Lazarus, 1988). In this study, coping means attempt to solve problems.	
Approach coping	Approach strategies work to consciously alter or acknowledge the stressor's role in one's life (MacIntyre *et al*., 2020). Approach coping include active coping, use of emotional support, use of instrument support, positive reinterpretation, planning and acceptance.
Avoidant coping	Avoidant coping mechanisms are more likely to lead to unhealthy responses like denial, distraction or drug abuse (MacIntyre *et al*., 2020). Avoidant coping include self distraction, denial, substance abuse, behavioural disengagement, focus on and vending of emotion, self blame.
Religion and humor	Religion is meant by trying to find comfort in religion, prayer or spiritual beliefs (Carver, 1997). Humor defines making jokes about it or making fun of the situation (Carver, 1997).
Mental health	

Mental health is assumed as an individual condition with regard to his or her psychological and emotional well-being (Walsh, 2011). In this study, mental health reflects one's psychological status.	
Depression	Depression is characterized by a lack of positive emotions such as pleasure, confidence, and enthusiasm (Barlow *et al*., 1998).
Anxiety	Anxiety defines physiological hyperarousal (Barlow *et al*., 1998).
Stress	Stress is a psychological response to stressful circumstances which has consequences to one's health (Lazarus, 2006).
COVID-19	
Coronavirus disease 2019 (COVID-19) is a deadly infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The respiratory tract is infected by COVID-19 that is caused by a novel coronavirus (SARS-CoV-2) (Shah *et al*., 2020).	
Pandemic	
Pandemic is meant by an epidemic that spreads globally. Epidemic is an outbreak that spreads over a larger geographical area (Grennan, 2019). COVID-19 spread rapidly to other countries and then WHO declared it as pandemic (World Health Organization, 2020).	
Wave-2	
A wave means a rising number of sick individuals, a defined peak, and then a decline. Ministry of Health Malaysia announced that the second wave of COVID-19 cases started on 27 February 2020 (The Star Online, 2020).	
Wave-3	
Ministry of Health Malaysia announced that the third wave of COVID-19 cases stated on 20 September 2020 (The Star Online, 2020).	

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter review the current literature related to COVID-19 pandemic in Malaysia and how the disease outbreak affects the psychological well-being. Then, this chapter also show the relationships between the study variables (mood and exercise behaviour, exercise behaviour and coping, exercise behaviour and mental health, coping and mental health). The conceptual framework of this study is provided at last.

2.2 Search terms and databases

Google scholar, Springer Link, ScienceDirect, Frontiers in Psychology were used for searching relevant journals, theses, and books. The literature search was conducted from April 2020 to May 2021. Key search terms used individually or in combination included mood, exercise, exercise behaviour, coping, mental health, Malaysian, COVID-19, and pandemic. When performing the search, the keywords were combined with Boolean operators like "AND" and "OR.". Table 2.1 shows literature search strategy.

Table 2.1 Literature Search Strategy

	Search Engine			
	Google Scholar	Springer Link	ScienceDirect	Frontiers in Psychology
Using Phrase				
Psychological wellbeing during COVID-19 pandemic in Malaysia	6,800	27	34	1,248

Impact of COVID-19 pandemic in Malaysia	23,600	457	604	743
COVID-19 pandemic in Malaysia	459	577	719	731
Using Boolean Operators and keywords (examples)				
"Mood" AND "exercise behaviour" during COVID-19 pandemic	67	7	8	3
"Exercise behaviour" AND "coping" during COVID-19 pandemic	60	77	8	2
"Exercise behaviour" AND "mental health" during COVID-19 pandemic	110	127	19	5
"Coping" AND "mental health" during COVID-19 pandemic	24,000	331	790	12

2.3 COVID-19 pandemic in Malaysia

COVID-19 outbreak was declared as pandemic by WHO on 11 March 2020. Malaysia had already implemented pandemic action plans. On 16 March 2020, Health Ministry have successfully undergone public health containment initiatives. The ministry will have to shift its policy from containment to mitigation when there is continue rising of cases (The Star Online, 2020). The mitigation's main goal is to encourage social distance between one person and another person, to avoid large crowds, to close schools and universities, to work from home and to reduce unnecessary travel to anywhere. The general public's social life is being disrupted, and mitigation would require public cooperation and participation.

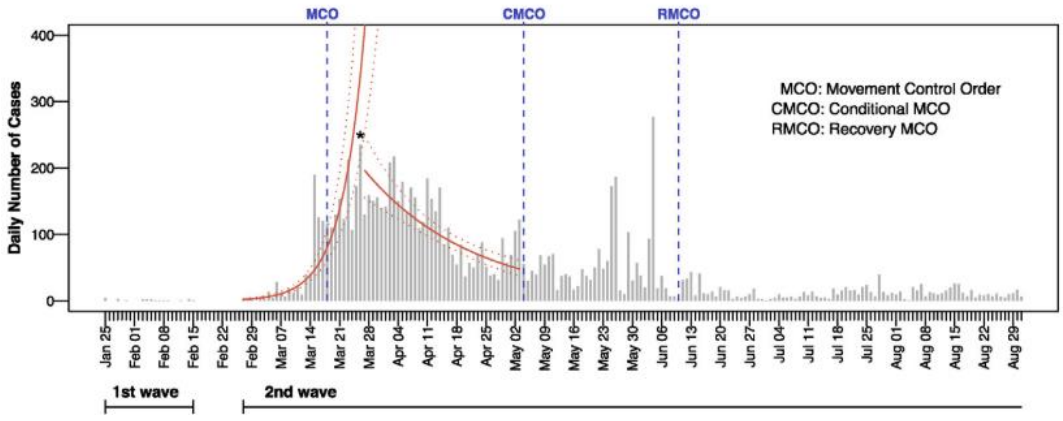

Figure 2.1 COVID-19 cases per day from 25 January to 31 August 2020

Note: Vertical bars reflect COVID-19 cases per day from 25 January to 31 August 2020. The start of control measures is indicated by vertical dashed lines. The estimated number of cases per day for the second wave is represented by solid curved lines. The 95 percent confidence interval is represented by dotted lines. Source: Adapted from Ng *et al*. (2020)

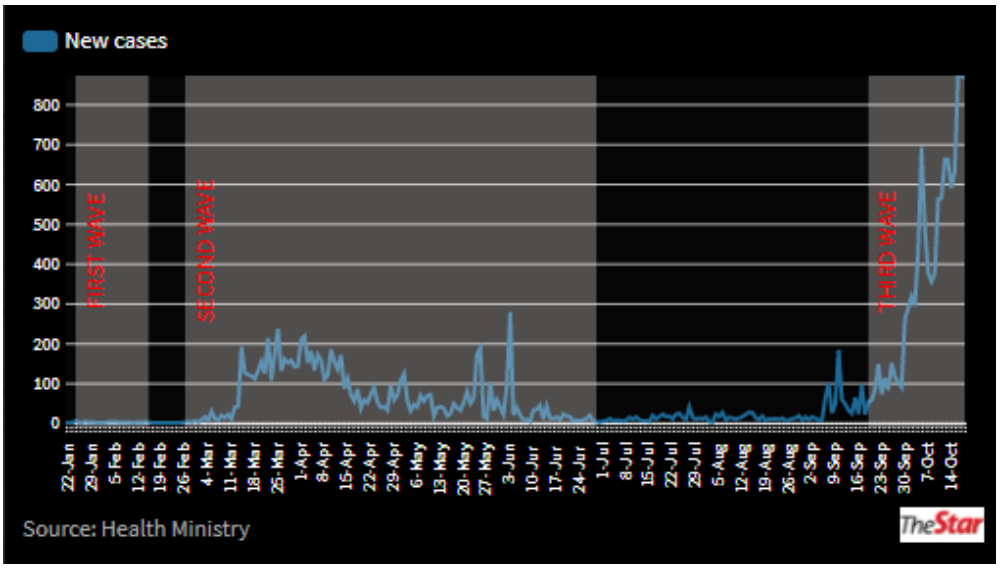

Figure 2.2 COVID-19 cases per day from 22 June to 14 October 2020

Note: COVID-19 cases per day from 22 June to 14 October 2020, shown as waves. Vertical shade bar indicates different stages of wave, they are first wave, second and third wave. Source: Adapted from The Star Online (2020)

On 23 January 2020, three China visitors had a tour in Johor, Malaysia from Singapore. Therefore, the first COVID-19 was announced by Malaysia on 25 January 2020. The Star Online (2020) indicated there is the first wave of cases on 16 February 2020 when the cases increased to twenty-two. On February 27, the second wave of cases was indicated when the

cases over one thousand. MCO was implemented on 18 March 2020. Next, the enhanced MCO was introduced on March 27 for managing huge outbreak clusters (Ng et al., 2020). Conditional Movement Control Order (CMCO) replaced MCO on May 4 for reopening the economy. Recovery Movement Control Order (RCMCO) was then implemented on June 10 as a result of the decrease in cases. All social activities are restored.

The third wave started on September 20. The third wave is started because of the increasing cases from clusters in Sabah, Kedah, and Selangor. According to The Star Online (2020), Sabah has seen a significant rise in cases since 7 September 2020. The number of clusters that emerged from those who travelled to Sabah from 22 September 2020. Government implemented Conditional Movement Control Order (CMCO) again on 14 October 2020. Restricted movement imposed on Putrajaya, Kuala Lumpur, and Selangor while for Sabah was imposed a day earlier. All state in West Malaysia implemented CMCO from 9 November to 6 December 2020 instead of Perlis, Pahang, and Kelantan. CMCO in Selangor (except Kuala Selangor, Shah Alam, Hulu Selangor), Kuala Lumpur and Sabah extended to 31 December 2020.

2.4 Disease outbreak and psychological wellbeing

Previous research has shown that public health crises have a long-term psychological effect (Chang *et al*., 2020). A mental health catastrophe can be regraded by the COVID-19 outbreak. In comparison to normal life stressors, this pandemic outbreak is a severe, widespread, and unmanageable source of stress (Liang *et al*., 2020). Usually, anxiety, embarrassment, personal and social loss, or vulnerability are some of the psychosocial reactions to such stressors (Verghese, 2004). 98.5 percent of respondents from Hunan province in China experienced

excessive anxiety, worrying, and nervousness as a result of the pandemic, considering it to be a severe threat (Chen *et al*., 2020).

Qiu *et al*. (2020) reported COVID-19 pandemic caused psychological distress to about 35 percent of population at large from Hong Kong, Macau, and Taiwan. In addition, participants were diagnosed with having depression during COVID-19 outbreak in China (Cai *et al*., 2020). During the first four weeks of the outbreak in March 2003, Maunder *et al*. (2003) recorded a similar situation in a Toronto teaching hospital about the psychological and workload effects of the outbreak. Feeling uncertain, anxious, getting upset easily, afraid of getting disease and transmitted disease to their family members and keep social distancing from one another emerged as common themes among staff and patients (Chan *et al*., 2005). When people are subjected to life-threatening conditions, they are more likely to develop mental illness (Catalan *et al*., 1996). SARS outbreak brought a serious impact on mental health, the associated factors like young age and increasing blame to themselves (Sim *et al*., 2010). Qiu *et al*. (2020) revealed young and older adults have the highest COVID-19 distress ratings.

Ali *et al.* (2021) study carried out in Malaysia for 10 weeks and the responses were divided into three periods of around 3 weeks: 25 January–21 February, 22 February–17 March and 18 March–3 April (the period the Malaysian Government issued Movement Control Order). The psychological and behavioural responses were discovered to increase as the pandemic progressed. The high anxiety levels discovered in this study urge for mental health intervention to be provided during the early stages of the COVID-19 pandemic. The psychological responses different in different time periods of COVID-19 pandemic. There was a growing number of respondents with a moderate to severe perception of severity over time is concerning.

Besides, a study from Australia conducted during COVID-19 pandemic reported there is evident of variations in mood scores over time, with profiles being most negative during

April and June. The mood fluctuations over time were triggered by events such as the varying geographical spread and control of the virus, the dramatic economic fallouts, and the differential tightening and easing of restrictions (Terry *et al*., 2020).

2.5 Mood state

Mood is characterized as "a set of feelings, ephemeral in nature, varying in intensity and duration, and typically including more than one emotion" (Lane and Terry, 2000). The iceberg profile was proposed by Morgan (1985) which characterized a mood responses patterns into above average scores (positive mood) with subscale vigor and below average scores (negative mood) with subscale tension, depression, anger, fatigue, and confusion. Terry *et al*. (2020) defined the increased risk of psychopathology is associated with negative moods. Previous research also showed that mood states are related positively to mental health (Sarkin *et al*., 2013). Monteagudo *et al*. (2013) reported higher levels of tension, depression, anger, fatigue, and confusion related to low vigor level, which is lead to a worse mental health status.

2.6 Exercise behaviour

Although many people are aware of the advantages of being physically active, not everybody starts or maintains a workout routine (Berger *et al*., 2002), and then many researchers revealed the understand of physical exercise adherence. Thogersen-Ntoumani and Ntoumanis (2006) determined the motivation underlying exercise behaviour may explain why certain people start or stop exercising. Deci & Ryan's (1991) continuum conception of extrinsic and intrinsic motivation developed the original BREQ (Mullan *et al.*, 1997) to measure external, introjected, identified, and intrinsic forms of regulation of exercise behaviour.

Self-determination theory (SDT) recommends people participated in activities for a variety of purposes or motivations, which is described as motivational regulations. Motivational regulations can be less or more self-determined (autonomous) (Deci and Ryan, 2002). SDT found behavioural regulations on a continuum of determination which is ranging from low autonomy (amotivation) to medium autonomy (extrinsic regulation), to high autonomy (extrinsic regulation), (intrinsic regulation) (Deci and Ryan, 1985). Therefore, these behavioural regulations include amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic regulation. In SDT, the degrees of behaviour internalization are indicated by these regulatory mechanisms, the transitioning of habits has been reflected and endorsed values and self-regulations are requested. This presents as particularly important in the study of exercise behaviour.

2.7 Coping strategies

Coping is a dynamic process that differs over time in response to changing demands and appraisals of the situation, but most individuals respond to stress in a consistent manner and only apply one style over a variety of situations (Endler, 2009). However, coping strategies, can be categorized as either healthy or unhealthy based on the potential of additional undesirable negative outcomes. Self-soothing, calming or distracting activities, social support, and professional support are all examples of healthy coping strategies. Negative self-talk, harmful behaviours (e.g., emotional eating, aggressiveness, alcohol, drugs, and selfharm), social withdrawal, and suicidality are all unhealthy categories. All coping mechanisms fall within this category (Stallman, 2020). The risk of increasing or decreasing for poor psychological functioning can depend on the way how individuals deal with a build-up of stress (Bartley and Roesch, 2011).

Other than that, the Brief COPE has also been categorized into approach coping, avoidant coping and neither approach nor avoidant coping (Dawson and Golijani-Moghaddam, 2020; Awoke *et al*., 2021). Approach coping with subscales of active coping, positive reframing, planning, acceptance, seeking emotional support, and seeking informational support which related to more beneficial responses to adversity such as improved physical wellbeing and more healthy mental states (Awoke *et al*., 2021). Besides, avoidant coping is defined by subscales like denial, substance use, venting, behavioural disengagement, self-distraction, and self-blame which is related to poorer physical health in certain medical conditions (Awoke *et al*., 2021). Lastly, neither approach nor avoidant coping included the subscales of humor and religious for coping with stress.

2.8 Mood and exercise behaviour

Moods make an impact on influence over feelings, thoughts, and behaviours (Lane, 2007). Lane (2007) showed that people's behaviour and performance are influenced by the interaction of mood components instead of any single mood component. Beedie *et al*. (2000) study showed unpleasant moods can help an individual performs better, while pleasant moods can make an individual performs worse through meta-analyses among athletes. Different mood components were examined the way they interact in influencing academic and sports performance (Lane and Terry, 2005). In this model, depressed mood is employed to describe sadness, displeasure, or distress instead of a clinical illness. Self-efficacy is a precondition of behaviour change (McAuley *et al*., 2001). "Coping responses" (Marlatt, 1985) can induce self-efficacy and improved outcomes. Low mood has been found to be related to a reduction in being self-regulated and self-efficacy (Baumeister and Heatherton, 1996), and positive mood may have good psychological health and therefore the established benefits of participating in an exercise programme on improving one's mood (Landers and Arent, 2007).

Physical activity is often incorporated into everyday life to foster social support and improve quality of life, leading to a substantial improvement in lifespan (Gremeaux *et al*., 2012; Vagetti *et al*., 2014). Exercise was already recognised as a primary coping mechanism for depression in adults (Rhyner and Watts, 2016), and it can be used in combination with conventional therapies, including antidepressant medication therapy to relieve symptoms of depression (Mura *et al*.,2014; Belvederi Murri *et al*., 2019). The net aversive effects would need to be outweighed by the net appetitive effects of exercise for exercise behaviour that repeated regularly and then individuals who undergo only minor improvements in mood as a result of exercise are unlikely to repeat the behaviour and become lifelong exercisers (Schutte *et al*., 2014). In a randomised controlled trial study conducted, there were more positive and less negative mood states among adults when self-efficacy was used in the model, but the frequency and social structures of exercise had the greatest impact on these mood states (McAuley *et al*., 2000).

Exercise is associated with better mood states and better subjective well-being in nondisabled residents aged 65 to 84 years old (Seino *et al*., 2019). Oddie *et al*. (2014) revealed that the mood of the participants improved significantly after engaging in physical exercise. Exercise levels were found to have a negative relationship with depression, stress, and emotional issues (Chekroud *et al*., 2018). Moreover, exercise termination can lead to negative effects on mental health (Weinstein *et al*., 2017). Because of COVID-19's high transmission rate, the public could become nervous and afraid (Wang *et al*., 2020). Healthcare professionals may experience stress, anxiety, or insomnia because they have a longer exposure period towards the COVID-19 outbreak (Spoorthy *et al*., 2020). People who have been diagnosed positively may experience discrimination or psychological distress (Zhai and Du, 2020), and the survivors may experience anxiety, depression, and post-traumatic stress disorder (Pfefferbaum and North, 2020).

Chang *et al*. (2020) found that respondents from 99 countries who engage more in physical activity during pandemic outbreak was related to mood improvement. Their study aimed to investigate the COVID-19's effect on exercise behaviour and mood states. Profile of Mood States (POMS) was used for measuring mood in their COVID-19 study while using one question about the frequency of people participating in physical activity to assess exercise frequency. In addition, the changes in the frequency of participating in physical activity moderate the effects of pre-pandemic exercise frequency on mood states (Chang *et al*., 2020).

Being less physically active was associated with having a more negative mood (Ingram *et al*., 2020). Their study adds to the negative effects of lockdown on mental health by identifying lifestyle constraints and changes in health habits that can, in part, account for the increased negative mood. Di Renzo *et al*. (2020) and Lopez-Nunez *et al*. (2021) reported during a lockdown, one of the ways to preserve healthier habits and reduce the adverse effects of lockdown on mood and wellness was by increasing their participation in physical activity.

2.9 Exercise behaviour and coping

The previous study indicated that exercise intention regulated predominantly the adolescents' exercise participation. The findings found individuals who expected outcome positively, high self-efficacy, and self-determination scores had stronger exercise intentions while spontaneous implementation intentions had no significant impact on physical activity engagement (Gerber *et al*., 2011). Fuchs *et al*. (2011) found when people have desire to take part in physical activity, they have a higher chance of doing so. Additionally, they recommend that individuals' exercise intentions influence their outcome expectations, self-efficacy beliefs, and degree of goal intention self-concordance with personal values.